Alp 393

Vytauto Didžiojo Universiteto Matematikos - Gamtos Fakulteto Darbai 1932—1933

Mémoire de la Faculté des Sciences de l'Universitè de Vytautas le Grand 1932 — 1933

T. VII

Zoologijos skyrius

Section de Zoologie

3 sąsiuvinys

Redaktorius e. o. prof. A. PURĖNAS

Kaunas :-: :-: „VILNIAUS" spaustuvė :-: :-: **1933**

Vytauto Didžiojo Universiteto Matematikos - Gamtos Fakulteto Darbai 1932—1933

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Kaunas :-: :-: „VILNIAUS" spaustuvė :-: :-: **1933**

PAUKŠČIŲ ŽIEDAVIMAS LIETUVOJE

iki 1932 m. gruodžio mėn. 31 d.

su 4 brėžiniais

Parašė

T. IVANAUSKAS,

Vytauto Didžiojo Un-to Ord. Profesorius

ir

A. VAITKEVIČIUS,

Vyt. Didž. Un-to Gamtos Muziejaus preparatorius

BAGUAGE DES OISEAUX EN LITHUANIE

jusqu'au 31 décembre 1932

avec 4 graphiques

Įvadas.

Paukščių žiedavimo darbą Lietuvoje pradėjo Lietuvos Universiteto Zoologijos Institutas 1929 metais.

Iš pradžios naudotasi skolintais Rasytės (Vokietijoje) paukščių stebyklos žiedais, bet 1931 metais pagaminti savi žiedai B, C, D, E serijų su parašu: „Université Kaunas Lithuanie" ir F, G serijų su parašu: „Université Lithuanie". Ligi 1932 m. gruodžio mėn. 31 d. sužieduota 9296 paukščiai ir gauta iš įvairių kraštų 77 pranešimai, apie pagautus ir šiaip sumedžiotus mūsų žiedais pažymėtus paukščius. Šių pranešimų gana didelė dalis gauta per Rasytės paukščių stebyklą. Tas liečia ypač rastus Vokietijoje ir Lenkijoje paukščius. Žvaigždelėmis (*), pastatytomis prie numerio šiame tekste, pažymėti Rasytės žiedai.

Daugiausiai buvo sužieduota jaunų paukščių lizduose. Didžiausis žiedavimų skaičius tenka šnekučiams, pempėms, varnoms ir gandrams, ir pranešimai liečia daugiausiai šias rūšis. Nors jaunų paukščių mirtingumas yra labai didelis ir jaunų žieduotų paukščių didesnė dalis žūsta pirmais savo gyvenimo mėnesiais, tačiau jaunų, lizde tebesančių paukščių žiedavimas turi tą gerą pusę, kad šiuo atveju yra tiksliai žinoma paukščio išriedėjimo vieta, o kai kada ir data. Žiedavimo praktika parodė, kad tos pačios rūšies, bet įvairių kraštų paukščiai, turi skirtingus kelius ir skirtingas žiemos buveines. Remiantis čia išdėstytomis išdavomis, pasidarė gana aiškus Lietuvos šnekučių migracijos vaizdas ir jų žiemos buveinė. Šis kelias eina pietų - vakarų - vakarų kryptimi ir baigiasi Belgijoje, Š. Prancūzijoje ir Anglijoje. Ilgiausias, žinomas mums, Lietuvoje išriedėjusio, Anglijoje nušauto šnekučio kelias yra 2100 klm. Be jaunų šnekučių, pažymėtų lizduose, esame pažymėję daug jaunų, bet jau skrendančių šnekučių, pagautų Ventės Rage (pusiausalis, įsikišęs į Kuršių Mares, einąs Nėrijai lygiagrečia kryptimi). Tiršti būriai šių paukščių traukia pro čia vakarų ir pietų-vakarų kryp-

timis. Kokios kilmės yra tie paukščiai, sunku pasakyti, bet galima spėti, kad jie atvyksta iš Latvijos, Estijos, dalinai iš Šiaurinės Lietuvos dalies. Jų kelias ir žiemos buveinė, kiek paaiškėjo iš mūsų žiedavimo išdavų, ta pati, kaip ir Lietuvoje gimusių paukščių.

Mūsų žiedavimo išdavos įrodo, kad jauni šnekučiai, išskridę iš lizdo neužilgo pradeda savo kelionę. Vidutiniškai mūsų šnekučiai išskrenda iš lizdo birželio mėn. pirmomis dienomis, o liepos mėnesio vidury esame gavę pranešimus apie juos iš Vokietijos, kur jie buvo nušauti, padarę apie 800 klm. pietų - vakarų kryptim (žiūr. Nr. 56, 66, 68). Pažymėtina, kad vis dėlto šnekučiai (tur būt, seni paukščiai) palieka Lietuvoje net iki spalių mėn. galo. Mūsų šnekučių žiedavimas toliau įrodė, kad jie iš savo žiemos buveinių grįžta ne tik į tą patį kraštą, bet dargi į tą patį lizdą, kur perėjo praėjusiais metais (žiūr. Nr. Nr. 41, 52, 53).

Mūsų pempės žiemos metu buvo nušautos Ispanijoje ir Portugalijoje, o pavasarį nuo 8.III iki 26.III Pietinėje Prancūzijoje. Kadangi šiuo laiku pempės Lietuvon jau esti atskridusios, tai galima būtų padaryti išvadą, kad jaunikliai atskrenda pas mus vėliau, nes kalbami, Prancūzijoje nušauti, individai buvo jaunikliai. Tolimiausis mums žinomas Lietuvos pempės padarytas kelias yra 2950 km. pietų-vakarų kryptimi.

Iš visų mūsų paukščių tolimiausią kelionę padaro kregždė (Hirundo rustica) ir baltasis gandras. Jiedu nuskrenda anapus ekvatoriaus į pietų pusrutulį. Mūsų kregždė G : 97 sumedžiota Rodezijoje po penkių su puse mėnesių nuo žiedavimo dienos. Ji padarė ne mažiau (tiesia linija matuojant) 8100 klm. pietų kryptimi (žiūr. Nr. 27). Pažymėtina, kad kregždės labai tiksliai grįžta į savo pernykštes buveines (žiūr. Nr. Nr. 24, 25, 26, 28).

Vienas mūsų gandras rastas negyvas Transvalyje maždaug 9 mėnesiams praslinkus nuo žiedavimo dienos. Jo padarytas kelias, tiesia linija matuojant, sudaro apie 9200 klm. pietų kryptimi. Apskritai imant, didelė dauguma mūsų paukščių traukia vakarų - pietų - vakarų kryptimi, tik kregždė, žalvarnė ir gandras traukia į pietus. Pastarasis iš pradžios pakrypsta net į rytus. Mūsų gi žalvarnė E : 1098, išskridus iš Lietuvos, atsidūrė Kretos saloje beveik tiksliai Kauno meridiane (žiūr. Nr. 22).

Vienu atveju pavyko tiksliai nustatyti išskridimo dieną iš vasaros buveinės. Turime omeny juodąjį gandrą (B : 454, kuris

buvęs visai prijaukintas, paskutinį kartą savo globėjo rankose buvo 9.IX.1932; per tris dienas, t. y., 12.IX.1932 m. pagautas palei Minską, padaręs apie 340 klm. kelio. Tuo būdu jo kelionės vidutinis greitumas yra apie 113 klm. dienai.

Šia proga dėkojame visiems asmenims, kurie padėjo mums žiedavimo darbe, ypač dėkojame p. daktarui E. Schüz, Rasytės Paukščių Stebyklos vedėjui, už suteiktus mums žiedus ir pranešimus apie mūsų žieduotus paukščius ir p. M. Posingiui, Ventės Rago švyturio prižiūrėtojui, už jo uolų ir sąmoningą darbą.

Paukščių žiedavimas Lietuvoje.

Didžioji antis. Anas platyrhyncha. L.

1. Žiedu C:39437* p. M. Želnys pažymėjo jauną didžiąją antį 29.VI.1930 Kauno aps. Lapių valsč. Žemaitkiemio dvare. Ši antis sumedžiota 5.XII.1931 Vokietijoje Lauenburg'o apskr. (upė Leba, Pommern). Laikotarpis 1 metai 5 mėnesiai ir 7 dienos. Atstumas nuo žiedavimo vietos 400 klm. WSW kryptimi.

2. Žiedu D:80 6.VII.1931 p. J. Okuličius pažymėjo jauną didžiąją antį Panevėžio apskr., Troškūnų valsč., Latavėnų dvare. Ši antis (patinas) nušauta 25.XI.1931 Vokietijoje apie Fischerhude 15 klm. nuo Bremeno, apie ką praneša p. S. Heinrich. Laikotarpis 4 mėnesiai ir 20 dienų. Atitolo nuo žiedavimo vietos 1080 klm. WSW kryptimi.

Pempė. Vanellus vanellus. (L).

3. Tarp 8.VI ir 22.VI.1929 p. M. Želnys Žemaitkiemio dvare, 12 klm. į šiaurę nuo Kauno, pažymėjo žiedu E:49165* jauną pempę. Ji buvo sumedžiota 26.III.1930 Prancūzijoje 30 klm. į šiaurę nuo Lijono ant vieno Amberieux-en-Dombes (Ain) ežero kranto, iš 200 — 300 galvų būrio; tas būrys tris dienas laikėsi šio ežero pakrašty. Laikotarpis apie 9 mėnesius, nutolo nuo žiedavimo vietos 1780 klm. SW kryptimi.

4. Jauną pempę žiedu E:57205* 15.VI.1930 Panevėžio aps., Dambavos valsč., Maneitų kaime pažymėjo p. V. Kurliandskas. Ši pempė pagauta 8.III.1931 Prancūzijoje prie Guiraud pilies, Sauterne, Gironde. Laikotarpis 8 mėnesiai 20 dienų. Atstumas 2150 klm. SW kryptimi.

5. Jauną pempę žiedu E:55209* 26.V.1930 Šakių aps., Sintautų valsč., Starkų kaime pažymėjo p. Ad. Kenigis. Ši pempė buvo pagauta Prancūzijoje, Vendays, Gironde 10.III.1931. Laikotarpis 7 mėnesiai ir 11 dienų, atstumas 2050 klm. SW kryptimi.

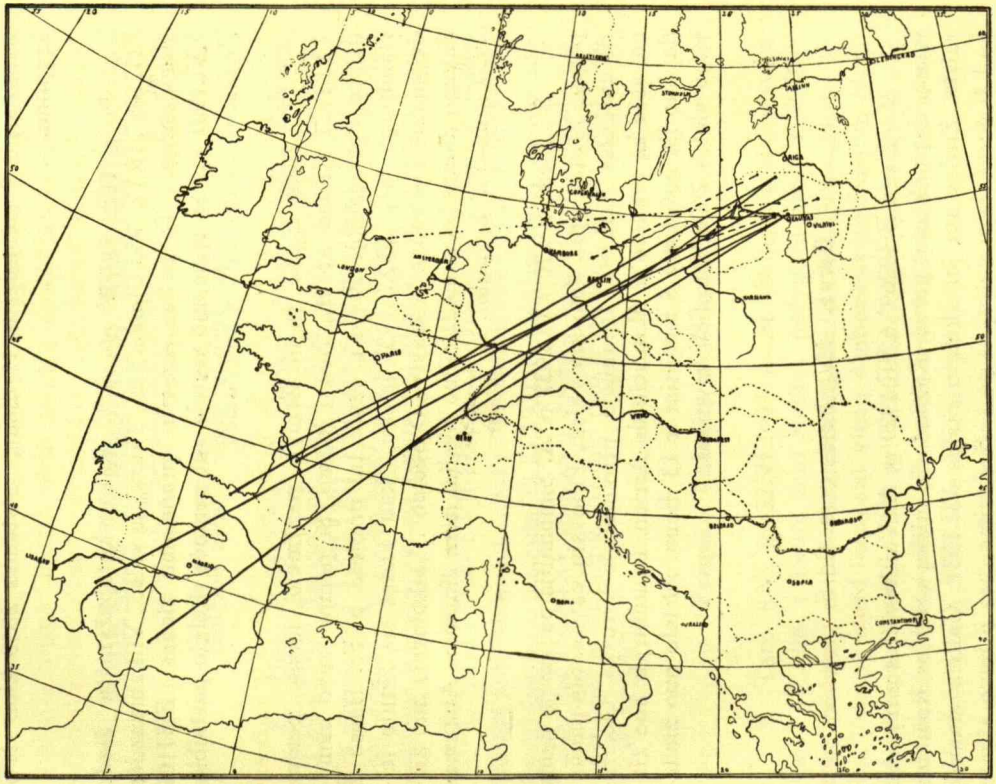
6. Jauna pempė p. Ant. Rakausko pažymėta žiedu E:57109*, 10.VI.1930 Utenos aps., Tauragnų valsč., Vilkablauzdės vienkiemyje. To paties asmens pranešimu žiedas E:57109 7.VI.1931 rastas žymėjimo vietoje ant pempės skeleto pastaibio. Paukščio žuvimo laikas nežinomas.

7. Žiedu E:352 p. M. Želnys pažymėjo jauną pempę 7.VI.1931 Kauno apskr., Rožių kaime. Ši pempė buvo sumedžiota Portugalijoje Elvas'e. Apie tai praneša p. Fr. Hasse iš Hamburgo savo 28.XII.1931 laišku, kad radęs šią žinutę leidžiamame Lissabone laikrašty „O Seculo". Laikotarpis nuo žiedavimo dienos iki sumedžiojimo tiksliai nėra žinomas. Atstumas 2950 klm. SW kryptimi.

8. Žiedu E:170 7.VI.1931 p. A. Simonaitis pažymėjo jauną pempę Šiaulių aps., Joniškio valsč., Plikiškių kaime. Šis paukštis nušautas 20.II.1932 Ispanijoje, provincijoje Vizcaya, Guernica, apie ką praneša p. Mauricio de Arrien. Laikotarpis nuo žiedavimo iki nušovimo 8 mėnesiai ir 13 dienų. Atitolo nuo žiedavimo vietos 2400 klm. SW kryptimi.

Gervė. Megalornis grus. (L).

9. Žiedu B:19269* 6.VII.1929 p. A. Vaitkevičius pažymėjo jauną, dar pūkuotą, gervę, Kaišiadorių miškų urėdijos Romatos raiste. Žiedas ant jos skeleto rastas VII.1931. Galima manyti, kad ši gervė žuvo netrukus po sužiedavimo, nes ji buvo atimta iš ją auginusio žmogaus ir laisvai paleista į raistą. Tur būt, ji žuvo negalėdama pati išmisti.



Keliai: ——— pempių, — — — varnų, —...— kovo.

Chemins: ——— des vanneaux, — — — des corneilles mantelées, —...— d'un freux.

Baltasis gandras. Ciconia ciconia. (L).

10. P. Vl. Bagdonas žiedu B:18504* liepos mėn. 1930 m. pažymėjo jauną baltąjį gandrą lizde Šiaulių apskr., Užvenčio valsč., Tolainių kaime. Šis paukštis buvo rastas negyvas Pietų Afrikoje, Transvalyje, netoli Germiston 5.IV.1931. Iš lavono stovio galima buvo spręsti, kad jis išgulėjo apie 14 dienų, apie ką praneša p. p. W. Lawrence ir P. O. Knights. Laikotarpis apie 9 mėnesius. Atstumas 9200 klm. Kryptis S.

11. Žiedu B:21524* p. B. Venislovas 6.VII.1931 pažymėjo jauną baltąjį gandrą Panevėžio apskr., Lėkiškėje (netoli nuo Panevėžio miesto). Paukštis rastas negyvas apie 25.VIII.1931. netoli Snovo miestelio, Nesvižio apskr. (lenkų okupuotoje Baltgūdijoje). Pranešdamas apie tai prof. Grochmalicki (Poznanės Universiteto Zoolog. Institutas) spėja, kad šis gandras buvo kitų gandrų pribaigtas, nes atrodė lyg liguistas. Laikot. apie metus ir pusantro mėn. Atst. 300 klm., SOS kryptimi.

12. Žiedu B:141 20.VII.1931 p. V. Bagdonas pažymėjo jauną gandrą Šiaulių apskr., Užvenčio valsč., Tolainių kaime. Šis gandras, užskridęs ant aukšto įtempimo elektros laido, buvo užmuštas 29.V.1932 Vokietijoje apie Nikolaiken Vakar. Prūsuose. Anot mokytojo p. Eisenberger, pranešusio šią žinią, tą pačią dieną per Nikolaiken pralėkė dar apie 50 gandrų vakarų kryptimi. Laikotarpis 10 mėnesių ir 18 dienų. Atstumas nuo žiedavimo vietos 300 klm. SW kryptimi.

13. Žiedu B:16 11.VII.1931 p. Mačionis pažymėjo jauną baltąjį gandrą, Garnių k., Švenčionių apskr., 22.VI.1932. Paukštis rastas negyvas Bulgarijoje apie Samboli, apie ką praneša p. Goritsa Cheshmedjiewa. Laikotarpis 11 mėnesių ir 20 dienų. Atstumas 1400 klm. S kryptimi.

Juodasis gandras. Ciconia nigra. (L).

14. Miškų urėdas, p. Vilčinskas, 26.VI.1930 pažymėjo žiedu B:21543* Draskų miške, 3 klm. nuo Gruzdžių miestelio, Šiaulių apskr. jauną juodąjį gandrą (pažymėtina, kad lizdas buvo su-

krautas ant žemės). Rasytės paukščių stebykla praneša, kad anot Vengrijos Karališko Ornitologijos Instituto Budapešte, šis paukštis buvo rastas negyvas Csongrad'o mieste 6.X.1930. Laikotarpis 3 mėnesiai ir 9 dienos. Nutolimas nuo žiedavimo vietos 1050 klm. SWS kryptimi.

15. Žiedu B:454 24.VII.1932 p. T. Zubavičius pažymėjo jauną juodąjį gandrą Biržų apskr., Daujėnų valsč., Dumblinėlių kaime. Anot žieduotojo pranešimo, paukštis buvęs visai jaukus ir vaikščiojęs laisvai kieme ir aplink namus. Paskutinį kartą žieduotojas matė jį 9.IX.1932, o 12.IX.1932, t. y., už trijų dienų jis buvo pašautas Baltgudijoje 13 klm. į SO nuo Minsko. Jam buvo nuimtas žiedas, bet pats jis kitą dieną paspruko, apie tai praneša Minsko universiteto prof. A. Fediušin. Laikotarpis 3 dienos, atstumas 340 klm. SO kryptimi.

Pilkasis garnys. Ardea cinerea. L.

16. P. St. Jankauskas pažymėjo žiedu C:36391* jauną, bet jau suaugusį pilkąjį garnį 18.X.1929 Aukšt. Fredoje prie Kauno. Paukštis buvo nušautas 5.X.1931 Ispanijoje apie Tortosa prov. Tarragona, apie ką praneša „Sociedad de Cazadores de Tortosa y su Distrito". Laikotarpis 1 metai, 11 mėnesių ir 16 dienų. Atstumas nuo žiedavimo vietos 2350 klm. SW kryptimi.

Karvelis keršulis. Columba palumbus. L.

17. Žiedu E:972 21.VIII.1932 p. T. Zubavičius pažymėjo jauną karvelį keršulį lizde Biržų apskr., Daujėnų valsč., Dumblinėlių kaime. Paukštis buvo pagautas gyvas Prancūzijoje Garonnos, netoli Marmande (Lot-et-Garonne), pakrašty, apie 2.X.1932, arba kiek anksčiau, nes pranešėjas p. Joseph Pons pastebėjo žiedą ant paukščio kojos „užmaunant jį ant iešmo". Laikotarpis 2 mėnesiai ir 22 dienos. Atstumas 2150 klm. SW kryptimi.

Keliai: ——— baltųjų gandrų, — — — juodųjų gandrų, — . . — pilkojo garnio.
Chemins: ——— des cigognes blanches, — — — des cigognes noires,
—. .— d'un héron cendré.

Paukštvanagis. Accipiter nisus. (L).

18. Jaunas, lizde esąs egzempliorius kartu su savo broliais, prof. T. Ivanausko pažymėtas žiedu E:42576* 23.VI.1928 Kaišiadorių miškų urėdijoje. Paukštis rastas negyvas 4.V.1929 Lenkijoje, Poznanės vaivadijoje, netoli Oborniki-Wronki. Laikotarpis 10 mėnesių ir 10 dienų. Atstumas 540 klm., kryptis SW.

19. Jaunas paukštvanagis tame pačiame lizdę ką ir Nr. 18 pažymėtas 23.VI.1928 žiedu E:41002* Kaišiadorių miškų urėdijoje. Nušautas rudenį 1928 m. Trakų apskr., Semeliškių valsč., Dergonių kaime. Atstumas apie 30 klm. SO kryptimi. Laikotarpis tiksliai nenustatytas.

Vakarinis suopis. Buteo b. buteo. (L).

20. Jaunas iš lizdo išimtas suopis prof. T. Ivanausko pažymėtas žiedu C:36294* 25.VII.1925 Obelynėje, 6 klm. nuo Kauno, buvo nušautas apie Zöllnitz, netoli Rochlitz Saksonijoje 16.II. 1929. Laikotarpis nuo žiedavimo dienos 3 metai 6 mėnesiai ir 18 dienų. Atstumas 855 klm., kryptis SW.

Pažymėtina, kad šis egzempliorius, paimtas iš lizdo Panemunės miške netoli Kauno kartu su savo broliu, buvo laikomas keletą savaičių nelaisvėje. Abudu paukščiai buvo maitinami mėsa ir šiaip negyvais gyvūnėliais. Per kiek laiko abudu paspruko, ir netrukus vienas jų buvo rastas negyvas, visiškai sulysęs, iš ko galima buvo spręsti, kad jis dvėsė badu. Šis faktas buvo visai suprantamas, turint galvoje, kad abudu paukščiai buvo maitinami patiektu jiems ir be to ne visai natūraliu maistu, o patys nebuvo pratę savistoviai maisto ieškoti. Todėl ytin vertas susidomėjimo faktas, kad antras egzempliorius ne tik pramoko pasirūpinti maisto, bet ir išgyventi laisvėje daugiau kaip tris ir pusę metų.

Pažymėtina, kad vakariniai suopiai neretai pastebimi Lietuvoje ir žiemos metu. Žiemos metu sumedžioti Vyt. Didž. Universiteto muziejaus trys egzemplioriai: Nr. 1440 (patelė) sumedžiota netoli Kauno 5.III.1929; Nr. 1816 sumedžiotas Panevėžio apskr. 7.I.1931 m. ir Nr. 1947 sumedžiotas apie Radviliškį 21.XII.

1932. Ar tai yra žiemuojantieji vietiniai egzemplioriai, ar paukščiai atkeliavę iš šiaurės, nustatyti tuo tarpu negalima.

21. Jauną vakarinį suopį žiedu C:42090* 15.VI.1930 Tauragės apskr., Tyrulių miške pažymėjo p. J. Andriukaitis. Liet. Tais. Medž. ir Žūklės D-jos Tauragės skyriaus valdyba pranešė, kad šis paukštis nušautas 2.X.1930. Tauragės apskr., Vainuto valsč., Balčių kaime. Laikotarpis 3 mėnesiai ir 16 dienų. Atitolimas nuo žiedavimo vietos 10 klm. NW kryptimi.

Žalvarnė. Coracias garrulus. L.

22. Žiedu E:1098 10.VI.1932 p. J. Buitkus pažymėjo jauną žalvarnę Tauragės apskr., Skaudvilės valsč., Kubiliškių kaime. Ši žalvarnė nušauta Graikijoje, Kretos saloje, apskr. Candia, miest. Vasilies, 10.IX.1932, apie ką praneša p. N. E. Kalathakis. Laikotarpis 3 mėnesiai. Atstumas 2150 klm. S kryptimi.

Čiurlys. Apus apus. (L).

23. P. Petraška prie Žemaitkiemio stoties Klaipėdos krašte pažymėjo žiedu G:71145* 30.VI.1930 čiurlį. Paukštis buvo vėl pagautas 17.VII.1930 durpių gamykloje Svencelio durpyne (Laukupių paštas). Laikotarpis 17 dienų. Nutolimas nuo žiedavimo vietos 15 klm. NW kryptimi.

Šelmeninė kregždė (blezdinga). Hirundo rustica. L.

24. P. K. Matijošaitis pažymėjo jauną šelmeninę kregždę žiedu G:88713* 26.VII.1930 Šakių apskr., Sintautų valsč., Starkų kaime. Tas pats žieduotojas pranešė, kad 21.V.1931 jisai pagavo tą patį paukštį žiedavimo vietoje, vadinasi, jaunas paukštis už metų grįžo tiksliai į savo gimtinę.

25. P. Matijošaitis pažymėjo seną šelmeninę kregždę žiedu G:88730* 1.VI.1930 Šakių apskr., Sintautų valsč., Starkų kaime. Tas pats žieduotojas pagavo šią kregždę 10.V.1931 ir vėl

ją paleido. Vėliau, būtent, 5.VI.1931, jis rado tą kregždę ten pat su nukąsta galva. Šiuo atveju senasis šelmeninės kregždės egzempliorius tiksliai grįžo po metų į žiedavimo vietą.

26. P. A. Mačikūnas žiedu G:68743* 2.V.1930 Panevėžio apskr. ir valsč.; Pakalnių kaime pažymėjo seną šelmeninę kregždę. Žieduotojas pagavo tą pačią kregždę 26.VII.1931 toje pačioje vietoje ir tame pačiame lizde, kur pernai perėjo ir buvo žieduota, ją vėl paleido laisvėn.

27. Žiedu G:97 p. Vl. Vaičiūnas pažymėjo jauną šelmeninę kregždę 30.VI.1931 Ukmergės apskr., Pagirių valsč., Maišimų kaime. Ši kregždė užmušta 14.XII.1931 Pietinėje Rodezijoje (Pietų Afrika), penkios mylios nuo Salisbury miesto. Pulkininkas Essex A. Capell praneša, kad ši kregždė buvo užmušta vietinio „negro, gaudžiusio skruzdes, jai išlekiant iš baltų skruzdžių (termitų?) skruzdėlyno". Laikotarpis nuo žiedavimo dienos iki užmušimo 5 mėnesiai ir 14 dienų. Atstumas nuo žiedavimo vietos 8100 klm. S kryptimi.

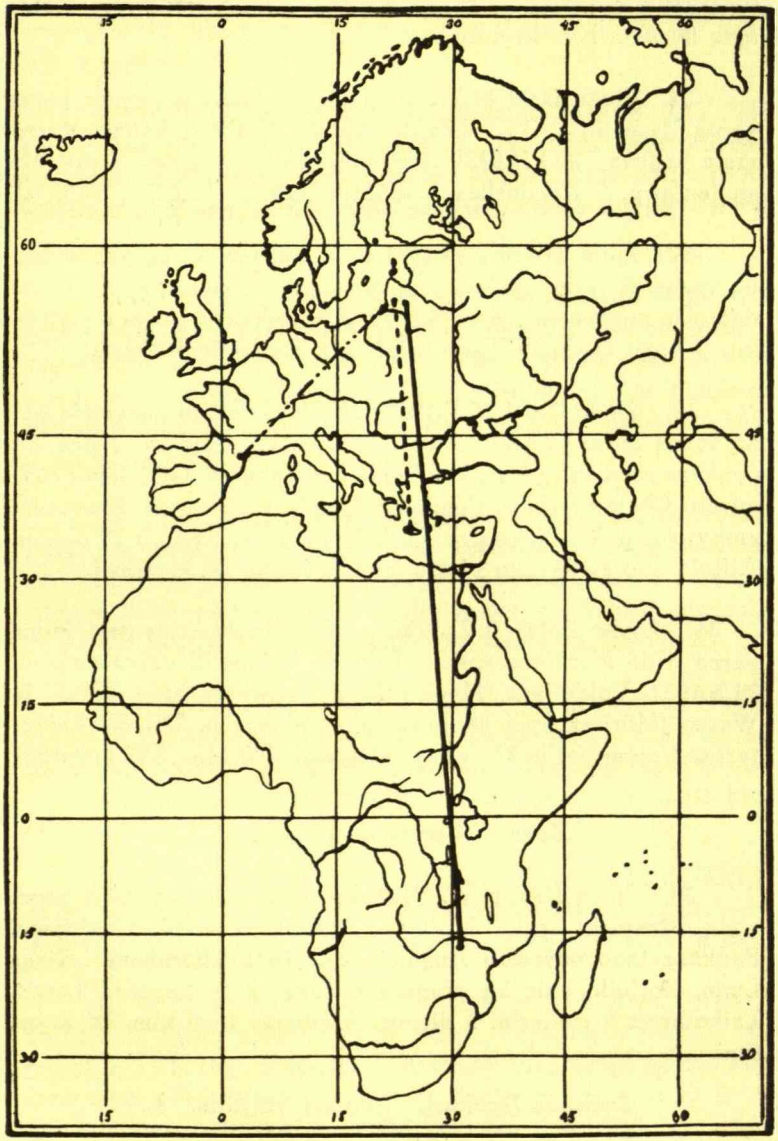
Langinė kregždė. Delichon urbica. (L).

28. P. Ant. Narbutas žiedu G:88647* 2.VII.1930 pažymėjo jauną langinę kregždę Raseinių apskr., Viduklės valsč., Papelkių kaime. Kregždė pagauta 1 klm. nuo žiedavimo vietos 26.V.1931.

Pilkoji varna. Corvus cornix. L.

29. P. D. Kukenis Biržų apskr., Čiuladų kaime (Antašavos paštas) 2.VI.1930 žiedu D:45675* pažymėjo jauną varną. Ji buvo vėl pagauta Panevėžio apskr., Kupiškio valsč., Bikonių kaime. Laikotarpis 4 dienų. Liko netoli nuo žiedavimo vietos.

30. Žiedu D:149 24.V.1931 p. J. Mantrimas pažymėjo jauną pilkąją varną Skapiškio valsč., Girvalakių kaime. Ši varna buvo nušauta Latvijoje, Bauskės apskr., Švitėnės valsč., Bencenų ūkyje, apie ką praneša p. Latvijos Universiteto Rektorius. Lai-



Keliai: ——— šelmeninės kregždės, — — — žalvarnės, —..— liepsnelės.
Chemins: ——— d'une hirondelle de cheminée, — — — d'un rollier, —..— d'un rouge-gorge.

kotarpis 8 mėnesiai ir 15 dienų. Atitolo nuo žiedavimo vietos apie 80 klm. NW kryptimi.

31. Žiedu D:90 24.V.1931 p. A. Narbutas pažymėjo jauną varną Raseinių apskr., Viduklės valsč., Ardiškių kaime. Varna rasta negyva 22.XII.1931 žiedavimo vietoje, apie ką praneša studentas p. A. Kaminskas (Viduklės paštas, Ardiškių kaimas).

32. Žiedu D:148 2.VI.1931 p. V. Žuromskas pažymėjo jauną varną Alytaus apskr., prie Miškų Mokyklos. Tas pats žieduotojas nušovė šią varną 6.II.1932 beveik toje pačioje vietoje, kur ji buvo žieduota. Laikotarpis 8 mėnesiai ir 8 dienos.

33. Žiedu D:121 25.V.1931 p. F. Vaitkevičius pažymėjo jauną varną Zarasų apskr., Antalieptės valsč., Gaidelių dvare. Šis paukštis rastas negyvas, kaž kieno sudraskytas, Lenkijoje netoli miesto Chojnice (Woj. Pomorskie), apie ką praneša gimnazijos mokytojas p. W. Blaszczyk. Laikotarpis 10 mėnesių ir 26 dienos. Atitolo nuo žiedavimo vietos apie 600 klm. W kryptimi.

34. Žiedu D:493 3.VI.1932 p. St. Januša pažymėjo jauną varną lizde Mažeikių apskr., Tulnikių kaime. Ši varna nušauta 25.X.1932 Vokietijoje Mecklenburg Schwerin apie Klink b. Waren (Müritz), apie ką praneša girininkas p. Thiede. Laikotarpis 4 mėnesiai ir 22 dienos, atstumas 700 klm. SW kryptimi.

Kovas. Corvus frugilegus. L.

35. Žiedu D:86 p. A. Narbutas 24.V.1931 pažymėjo jauną kovą Raseinių apskr. ir valsč., Kazakaučyznos vienkiemy. Paukštis tapo nušautas Anglijoje 29.X.1931 Thornham, Kings Lynn, Norfolk, apie ką praneša nušovęs jį p. Leonard Lewis. Laikotarpis 5 mėnesiai 5 dienos. Atstumas 1500 klm. W kryptimi.

Šnekutis (špokas). Sturnus vulgaris. L.

36. P. Ad. Kenigis Šakių apskr., Starkų kaime, Sintautų valsč. pažymėjo žiedu F:70214* jauną šnekutį lizde 23.V.1930. Paukštis buvo katės pagautas sodyboje Kinderweit-

schen (Eitkūnų paštas) Vokietijoje 17.VII.1930. Laikotarpis 1 mėnuo ir 24 dienos, nutolimas nuo žiedavimo vietos 40 klm., SW kryptimi.

37. P. St. Jankauskas pažymėjo žiedu F:60048* 30.V.1930 A. Fredoje prie Kauno jauną šnekutį lizde. Šis egzempliorius nušautas 22.VII.1930, netoli Dassow, Meklenburge. Laikotarpis 1 mėnuo 22 dienos, atitolo nuo žiedavimo vietos 865 klm. WSW kryptimi.

38. P. J. Žulys žiedu F:68988* 2.VI.1930 Utenos valsč., Kavynės kaime pažymėjo jauną šnekutį lizde. P. J. Peeters paukštį sumedžiojo 22.X.1930 Duffel'yje, 12 klm. į pietus nuo Antwerpen'o (anot Musée Royal d'Histoire Naturelle de Belgique, Bruxelles). Laikotarpis 4 mėnesiai ir 19 dienų. Nutolimas 1450 klm. WSW kryptimi.

39. P. M. Lekavičius, Panevėžio apskr., Troškūnų valsč., Latavėnų dvare pažymėjo žiedu F:68926* jauniklį varnėną 29.VI.1930. Šis paukštis rastas negyvas tų pačių metų lapkričio mėnesį Panevėžio apskr., Šilagalio lauke, taigi už 5 mėnesių, nuskridęs per 32 klm. nuo žiedavimo vietos W kryptimi.

40. P. Valiūno žiedu F:69005* 24.V.1930 pažymėtas Kauno apskr., Rumšiškio valsč., Dovainonių kaime jaunas šnekutis lizde, rastas negyvas 26.III.1931 pietinėje Olandijoje apie Gorinchem. Laikotarpis 10 mėnesių ir 1 diena. Atstumas 1300 klm. W kryptimi.

41. P. K. Matijošaitis pažymėjęs žiedu F:72518* 5.VI.1930 Šakių apskr., Sintautų valsč., Starkų kaime jauną šnekutį lizde, pagavo tą patį paukštį tame pačiame lizde 1931 m. kovo mėnesį.

42. P. J. Narbutas pažymėjo jauną šnekutį žiedu F:70147* 24.VI.1930 Šakių apskr., Jankų valsč., Vinkšnupių kaime. Šis paukštis 5.VII.1931 nušautas Vokietijoje, Hamburgo apskr. apie Hessbögel (Steinkirchen'o paštas). Laikotarpis 1 metai ir 11 dienų, atstumas 1050 klm. WSW kryptimi.

43. P. Petrilionio pažymėtas jaunas šnekutis žiedu F:501 2.VI.1931 Biržų apskr., Daujėnų valsč., Girsūdų kaime. Šis

paukštis rastas negyvas 26.VIII.1931 apie 9 val. rytą Vokietijoje Mecklenburge prie kelio Ganschendorf-Beggerow, kur jis, palietęs aukšto įtempimo elektros laidus, užsimušė. Laikotarpis 2 mėnesiai ir 25 dienos, atstumas 795 klm. WSW kryptimi.

44. P. Alb. Ažubalio pažymėtas žiedu F:726 jaunas šnekutis 31.V.1931 Biržų apskr., Vabalninko valsč., Stuburų kaime, nušautas Vokietijoje 20.VII.1931 („per apsirikimą, vietoje strazdo"), Grimhoff'e, Fischhausen'o apskr. (Rytprūsiai). Praneša per Rasytės stebyklą p. D. Feldmann. Laikotarpis 1 mėnuo ir 20 dienų, atstumas 320 km. SW kryptimi.

45. P. J. Mickus žiedu F:1033 pažymėjo jauną šnekutį 4.VI.1931 Panevėžio apskr., Krekenavos valsč., Ibutonių kaime. Šis paukštis nušautas 8.VIII.1931. Vokietijoje apie Neurese Kolberg'o apskr., apie ką per Rasytės stebyklą praneša p. Dr. O. Dibbelt. Laikotarpis 2 mėnesiai ir 4 dienos. Atstumas 570 klm. WSW kryptimi.

46. P. St. Lukšta žiedu F:1201 pažymėjo jauną šnekutį 10.VI.1931 Utenos apskr., Malėtų apylinkėse. Šis paukštis, anot p. Rebell pranešimo, 6.X.1931. buvo katės pagautas Vokietijoje, Schlochau apskrity (paštas Prechlau). Laikotarpis 3 mėnesiai ir 26 dienos. Atitolo nuo žiedavimo vietos 750 km. SW kryptimi.

47. P. Vl. Nagevičius žiedu F:68997* pažymėjo jauną šnekutį 1.VI.1930 Šiaulių apskr., Kriukų valsč., Puraičių kaime. Musée Royal d'Histoire Naturelle de Belgique (Bruxelles) praneša, kad šis paukštis buvo nukautas 12.X.1931 Belgijoje, Malines tarp Bruselio ir Antverpeno. Laikotarpis 1 metai, 4 mėnesiai ir 11 dienų. Atstumas nuo žiedavimo vietos 1350 klm. SW kryptimi.

48. Žiedu F:362 p. M. Petraitis pažymėjo jauną šnekutį 30.VI.1931 Marijampolės apskr., Prienų mieste. Paukštis nušautas 9.IX.1931 Lenkijoje Sosno Szlacheckie (powiat Brodnica, woj. Pomorskie), apie ką praneša prof. Dr. Domaniewski. Laikotarpis 2 mėnesiai ir 9 dienos, atstumas 400 klm. W kryptimi.

49. Žiedu F:922 p. K. Danielis pažymėjo jauną šnekutį 2.VI.1931 Rokiškio apskr., Panemunio valsč., Roviškio dvare. Paukštis nušautas Lenkijoje, Semlin'e (pow. Starogard, woj. Pomorskie), apie ką praneša prof. Dr. Domaniewski. Laikotarpis 3 mėnesiai ir 9 dienos, atstumas 485 klm. SW kryptimi.

50. Žiedu F:393 p. F. Vaitkevičius pažymėjo jauną šnekutį 25.V.1931 Zarasų apskr., Antalieptės valsč., Gaidelių dvare. Šis paukštis buvo sumedžiotas Belgijoje, Blankenberghe, jūros pakrašty 13.XI.1931. Jį sumedžiojo p. Stragier, apie ką praneša „Musée Royal d'Histoire Naturelle de Belgique" Bruxelles. Laikotarpis 5 mėnesiai ir 19 dienų. Nutolo nuo žiedavimo vietos 1570 klm. WS kryptimi.

51. Žiedu F:72586* p. M. Rudzianskas pažymėjo jauną šnekutį 15.VI.1930 Kėdainių apskr., Gudžiūnų valsč., Devinduonių kaime. Šis paukštis, užskridęs ant Helgolando švyturio naktį 30/31.III.1932 (nuo 4 iki 6 val.), buvo pagautas ir, pakeitus mūsų žiedą Helgolando stebyklos žiedu 610830 A, buvo vėl paleistas. Laikotarpis 1 metai 9 mėnesiai ir 13 dienų. Atstumas 1035 klm. W kryptimi. Yra pagrindo manyti, kad šis paukštis skrido atgal į savo tėviškę iš žiemavimo vietos.

52. Žiedu F:68947* p. A. Smitas pažymėjo seną šnekutį 21.V.1931 pagavęs jį lizde, Vilkaviškio apskr., Gižų valsč., Oranų kaime. Tas pats žieduotojas toje pačioje vietoje ir tame pačiame lizde pagavo šį šnekutį vėl 5.IV.1932 ir vėl jį paleido. Senas paukštis už metų grįžo į savo pernykštį lizdą.

53. Žiedu F:68952* p. A. Smitas pažymėjo seną šnekutį, pagautą lizde 21.V.1931 Vilkaviškio apskr., Gižų valsč., Oranų kaime. Tas pats žieduotojas 5.IV.1932 pagavo tame pačiame lizde tą patį paukštį; vadinasi, paukštis už metų buvo grįžęs į tą pačią vietą ir lizdą.

54. Žiedu F:3812 7.VII.1932 p. M. Posingis pažymėjo jauną tinklu pagautą šnekutį Šilutės apskr., Ventės Rage (Kintų paštas). Šis šnekutis nušautas 31.VII.1932 Vokietijoje, apie Montau, netoli Leyden ir Karaliaučiaus. Praneša med. stud. p. A. Reiter. Laikotarpis 24 dienos. Atitolo nuo žiedavimo vietos 85 klm. SW kryptimi.

55. Žiedu F:1361 22.VI.1932 p. M. Posingis pažymėjo jauną tinklu pagautą šnekutį Šilutės apskr., Ventės Rage (Kintų paštas). Anot pranešėjo p. C. Knuth 4.VIII.1932 iš Vokietijos, Mecklenburg, Bad Doberan, šis paukštis buvęs ten paukštvanagio sudraskytas. Tikslesnė data nežinoma. Laikotarpis apytikriai 1 mėnuo ir 11 dienų. Atitolo nuo žiedavimo vietos 620 klm. W kryptimi.

56. Žiedu F:1589 26.V.1932 p. Posingis pažymėjo jauną tinklu pagautą šnekutį Šilutės apskr., Kintų valsč., Ventės Rage. Paukštis rastas negyvas 14.VII.1932 Vokietijoje, Twielenfleth, Kr. Jork, Regierungsbezirk Stade, apie ką, Helgolando stebyklai tarpininkaujant, praneša Dr. O. Schröder, Kilio Universiteto Zoologijos Muziejaus vedėjas. Laikotarpis 1 mėnuo, 19 dienų. Atstumas 780 klm. WSW kryptimi.

57. Žiedu F:3130 21.VI.1932 p. M. Posingis pažymėjo jauną šnekutį, pagautą tinklu Šilutės apskr., Kintų valsč., Ventės Rage. Šį paukštį VIII.1932 (tikslesnė data nepranešta), pagavo katė Vokietijoje, Holstein'e apie Schönberg, dvare Schmal. Apie tai praneša Dr. O. Schröder, Kilio Universiteto Zoolog. Muz. vedėjas. Laikotarpis apie 2 mėn. Atstumas 720 klm. WSW kryptimi.

58. Žiedu F:3061 20.VI.1932 p. M. Posingis pažymėjo jauną, tinklu pagautą šnekutį Šilutės apskr., Kintų valsč., Ventės Rage. Paukštis rastas Vokietijoje netoli Barth a. d. Ostsee Fuhlendorf'o kaime 15.VIII.1932, apie ką praneša mokytojas p. E. Mattke. Laikotarpis 1 mėnuo ir 26 dienos. Atstumas 560 klm. WSW kryptimi.

59. Žiedu F:3845 7.VII.1932 p. M. Posingis pažymėjo tinklu pagautą jauną šnekutį Šilutės apskr., Kintų valsč., Ventės Rage. Paukštis nušautas Vokietijoje, Rytprūsiuose apie Skaisgirį (Skaisgirren), Laukininkuose (Laukeninken), apie ką praneša ponia J. Skibbe savo laišku iš 25.VIII.1932, nenurodydama paukščio nušovimo dienos. Laikotarpis apie pusantro mėn. Atstumas 60 klm. SWS kryptimi.

60. Žiedu F:1591 26.V.1932 p. M. Posingis pažymėjo jauną šnekutį lizde Šilutės apskr., Kintų valsč., Ventės Rage. Paukš-

tis nušautas 11.VIII.1932 Lenkijoje Hel'io pusiasalio pamate, kaime Wielka Wieś, apie ką praneša prof. J. Domaniewski iš Varšuvos. Laikotarpis 2 mėn. ir 16 dienų. Atstumas 170 klm. SW kryptimi.

61. Žiedu F:1387 21.VI.1932 p. M. Posingis pažymėjo jauną, tinklu pagautą, šnekutį. Anot „Staatliche Biologische Anstalt auf Helgoland", šis paukštis pagautas Helgolande naktį 28/29. X.1932 ir vėl paleistas. Laikotarpis 4 mėn. ir 7 dienos. Atstumas 870 klm. W kryptimi.

62. Žiedu F:1341 22.VI.1932 p. M. Posingis pažymėjo jauną, tinklu pagautą, šnekutį, Šilutės apskr., Kintų valsč., prie Ventės Rago švyturio. Paukštis sumedžiotas Belgijoje 25 klm. nuo Antverpeno, Esschen'e, Olandijos pasieny, apie ką praneša „Musée Royal d'Histoire Naturelle de Belgique" Bruxelles. Laikotarpis 3 mėn. ir 3 dienos. Atstumas 1200 klm. W kryptimi.

63. Žiedu F:2091 30.V.1932 p. J. Jažemskis pažymėjo jauną šnekutį Kėdainių apskr., Baisogalos valsč., Juodupių kaime. Šis paukštis nušautas vyšnių medžiuose 20.VII.1932 Vokietijoje, Rytprūsiuose, netoli Pillau. Apie tai praneša uosto statybos įstaiga. Laikotarpis 1 mėnuo ir 20 dienų. Atstumas 270 klm. WSW kryptimi.

64. Žiedu F:72477* 5.VI.1930 p. V. Račys pažymėjo jauną šnekutį lizde Šiaulių apskr., Pašvitinio valsč., Vaiškonių kaime. Paukštis rastas 7.VII.1932 Vokietijoje, žemutinėje Elboje, Regierungsbezirk Stade, Hallern. Apie tai, Rasytės stebyklai tarpininkaujant, pranešė mokytojas p. B. Behnken. Laikotarpis 2 metai, 1 mėnuo ir 1 diena. Atstumas 950 klm. WSW kryptimi.

65. Žiedu F:2517 29.V.1932 p. J. Jurgaitis pažymėjo jauną šnekutį Šiaulių apskr., Radviliškio valsč., Vismantų II kaime. Šis paukštis rastas negyvas Šilutės apskr., Pašyšiuose, apie ką praneša p. Waldemar Gilde savo laišku iš 11.VII.1932. Laikotarpis 1 mėnuo ir 12 dienų, atstumas 140 klm. SW kryptimi.

66. Žiedu F:2875 3.VI.1932 p. J. Kairys pažymėjo jauną šnekutį lizde Panevėžio apskr., Šimonių valsč., Migonių kaime.

Šis paukštis nušautas Vokietijoje Halstein'e apie m. Barlt 21.VII. 1932, apie ką praneša p. H. Altenberg iš Barlt'o. Laikotarpis 1 mėnuo ir 19 dienų, atstumas 1000 klm. WSW kryptimi.

67. Žiedu F:3525 4.VI.1932 p. Pr. Gervė pažymėjo jauną šnekutį lizde Kauno apskr., Pakuonių valsč., Girininkų kaime. Šis paukštis 21.VII.1932 pagautas tinklu Vokietijoje, Eiderstedt'o apskr., Tönning'e, apie ką patyrėme Rasytės stebyklai tarpininkaujant. Laikotarpis 1 mėnuo ir 18 dienų, atstumas 990 klm. W kryptimi.

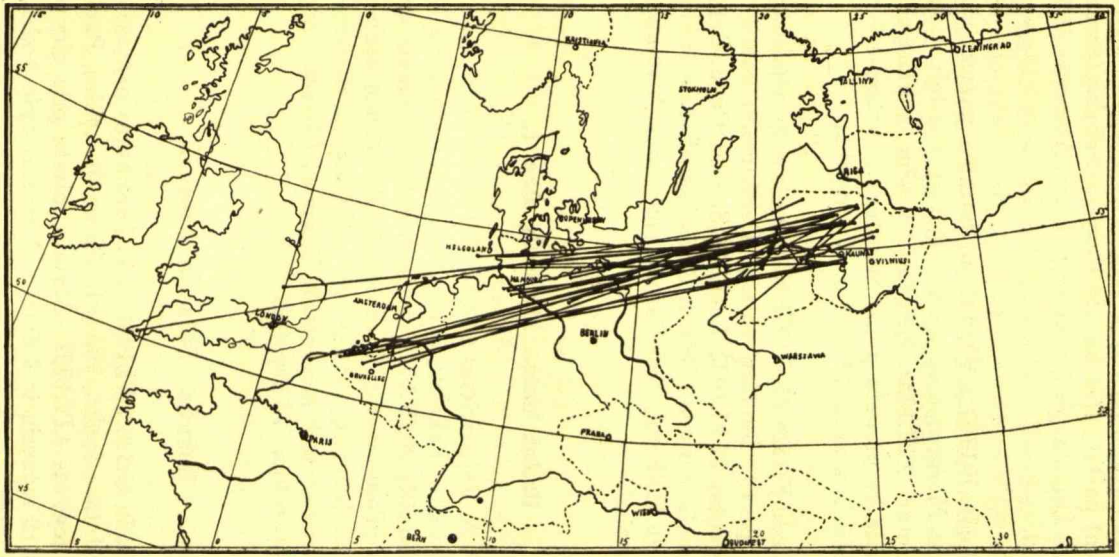
68. Žiedu F:1205 12.VI.1931 p. St. Lukšta pažymėjo jauną šnekutį lizde Utenos apskr., Malėtų apylinkėse. Paukštis rastas Vokietijoje, Įsrutyje (Insterburg), 13.VII.1932, apie ką, tarpininkaujant Rasytės stebyklai, praneša p. H. Retzloff. Laikotarpis 1 metai 1 mėnuo ir 1 diena. Atstumas 240 klm. SW kryptimi.

69. Žiedu F:1819 1.VI.1932 p. M. Petraitis pažymėjo jauną šnekutį lizde Prienų miestely. Paukštis rastas Rytprūsiuose, Gumbinės (Gumbinnen) apskr., Jogailėnuose 15.VII.1932, apie ką praneša p. K. Dzewas. Laikotarpis 1 mėnuo ir 15 dienų. Atstumas 114 klm. W kryptimi.

70. Žiedu F: 1122 7.VI.1931 p. J. Brinkis pažymėjo jauną šnekutį lizde Šiaulių apskr., Radviliškio valsč., Vismantų kaime. Šis paukštis sumedžiotas rudenį 1931 m. (tikslesnė data nenurodoma). Belgijoje, 5 klm. nuo Bruges, kaime Dudzeele, apie ką praneša „Musée Royal d'Histoire Naturelle de Belgique". Laikotarpis apie 5 mėn. Atstumas 1400 klm. WSW kryptimi.

71. Žiedu F:2434 17.VI.1932 p. J. Brinkis pažymėjo jauną šnekutį lizde Šiaulių apskr., Radviliškio valsč., Vismantų I kaime. Šis paukštis sumedžiotas 24.X.1932 Belgijoje, prov. Flandre Orientale, Lovendeghem les Gand teritorijoje, apie ką praneša p. Henri Haeck. Laikotarpis 4 mėnesiai ir 7 dienos. Atstumas 1450 klm. WSW kryptimi.

72. Žiedu F:2930 29.V.1932 p. J. Brinkis pažymėjo jauną šnekutį lizde Šiaulių apskr., Radviliškio valsč., Vismantų II kai-



Lietuvos šnekučių keliai.
Chemins des etourneaux bagués en Lithuanie.

me. Šis paukštis rastas negyvas sode 7.VIII.1932 Rytprūsiuose, Įsručio (Insterburg) apskr., Aukštkalny (Auxkollen), Peleninkų (Pelleningken) paštas, apie ką per Rasytės stebyklą praneša p. E. Embacher. Laikotarpis 2 mėn. ir 9 dienos. Atstumas 160 klm. SW kryptimi.

73. Žiedu F:1800 1.VI.1932 p. Petraitis pažymėjo jauną šnekutį lizde Marijampolės apskr., Prienų miestely. Paukštis sumedžiotas 2.XI.1932 Belgijoje, 2 klm. į vakarus nuo Ostendes, apie ką praneša p. De Meester. Laikotarpis 5 mėnesiai ir 1 diena. Atstumas 1500 klm. W kryptimi.

74. Žiedu F:2526 22.V.1932 p. Paliulis pažymėjo seną šnekutį Biržų apskr., Daujėnų valsč., Dumblinėlių kaime. Šis paukštis nušautas 22.XI.1932 Anglijoje Sennen Cove, Cornwall, apie ką praneša žurnalo „British Birds" redakcija (London W. C. 1 326, High Holborn). Laikotarpis 6 mėnesiai. Atstumas 2100 klm. W kryptimi.

Baltoji kielė. Motacilla alba. L.

75. P. A. Vaitkevičius žiedu G:93134* 10.VII.1930 Panevėžio apskr. ir valsč., Pakalnių kaime pažymėjo lizde jauną baltąją kielę. Šis paukštis 29.IV.1931 rastas negyvas daržinėje ant vežimo sėdynės Panevėžio apskr. ir valsč., Pažagienių kaime, apie ką praneša šio kaimo gyventojas p. J. Šilinskas. Laikotarpis nuo žiedavimo iki radimo 9 mėnesiai ir 18 dienų. Atstumas nuo žiedavimo vietos 6 klm. W kryptimi.

Bukutis. Sitta europaea. L.

76. Žiedu G:528 2.VI.1931 p. V. Žuromskas pažymėjo jauną bukutį Alytaus apskr., šile prie Miškų Mokyklos. Paukščiukas rastas negyvas 4.IV.1932 Alytaus mieste prie gimnazijos. Laikotarpis 10 mėnesių ir 2 dienos, Atstumas apie 3 klm. nuo žiedavimo vietos.

Liepsnelė. Erithacus rubecula. (L).

77. Žiedu G:3517 21.X.1932 p. M. Posingis pažymėjo pagautą tinklu liepsnelę Šilutės apskr., Ventėje. Šis paukštis katės pagautas Prancūzijoje depart. Alpes-Maritimes (Marino Quartier des Cayrons, Vence) 27.XII.1932, apie ką praneša p. J. Laurenti. Žiedo nešiojimo laikotarpis 2 mėnesiai ir 6 dienos, padarytas kelias 1650 klm. SW kryptimi.

Sąrašas paukščių, žieduotų kituose kraštuose, bet rastų Lietuvoje.

Rudgalvis kiras. Larus ridibundus. L.

1. Žiedu „C. 6369 Mus. Zool. Helsingfors" žieduotas rudgalvis kiras, nušautas 15.X.1929 Rekijavos ežero pakrašty. Anot Helsinkių Muziejaus pranešimo, šis paukštis buvo žieduotas 12.VI.1929 netoli Helsinkių.

2. Žiedu „C. 4471. Museum Göteborg Sweden" žieduotas rudgalvis kiras, nušautas Sartų ežere 30.VIII.1927.

Smailiauodegis plėšikas. Stercorarius parasiticus. L.

3. Žiedu „E. 72709 Vogelwarte Rossitten Germania" žieduotas smailiauodegis plėšikas buvo nušautas 16.IX.1931. Ventės Rage, Kintų valsč., Šilutės apskr. Šis paukštis buvo sužieduotas 7.IX.1931 Rasytėje, Rytprūsiuose. Žieduotojas — Rasytės paukščių Stebėjimo Stotis.

Griežlė. Crex crex. (L).

4. Žiedu „Ornithol. Centr. Riga 44080" žieduota griežlė, rasta sudraskyta Kretingos apskr., Salantų valsč., Baidotų kaimo pievoje. 1931 m. rugpiūčio m. 1 — 8 d. Šis paukštis buvo sužieduotas kaipo jauniklis 14.VIII.1930 m. palei Adaži, 40 klm. į ONO nuo Rygos, Latvijoje.

Juodasis gandras. Ciconia nigra. L.

5. Žiedu „Ornith. Centr. Riga 49742" žieduotas juodasis gandras buvo rastas su nulūžusia koja Sauserių kaime, Kulių valsč., Kretingos apskr. 2.IX.1931. Šis paukštis buvo sužieduotas 2.VII.1931 palei Aizpute (Hasenpoth), Latvijoje.

Pilkasis garnys. Ardea cinerea. L.

6. Žiedu „B. 21970 Vogelwarte Rossitten Germania" žieduotas garnys buvo nušautas rugpiūčio mėn. 1930 m. prie Glėbo ežero, Alytaus apskr., Varėnos valsč. Šis paukštis buvo sužieduotas 23.V.1930 m. kaip jauniklis lizde, garnių kolonijoje „Adlershorst", Vokietijoje, apie 10 klm. į rytus nuo Neidenburg'o. Žieduotojas „Jägersbatallion" Ortensburg.

7. Žiedu „B. 26110 Vogelwarte Rossitten Germania", pažymėtas pilkasis garnys buvo nušautas Ukmergės apskr., netoli Siesikų 1931 m. liepos mėn. Anot Rasytės stebyklos pranešimo, jis buvo pažymėtas kaip jauniklis lizde apie Johannisburg'ą (Wolka miškas, Drygallen urėdija) 28.V.1931.

8. Žiedu „B. 18859 Vogelwarte Rossitten" pažymėtas garnys, nušautas 1929 m. vasarą Ramygalos valsč., Pašilių kaimo lauke. Anot Rasytės stebyklos pranešimo, jis buvo sužieduotas jaunas 7.VI.1929 garnių kolonijoje Juodkrantėje.

Paukštvanagis. Accipiter nisus. (L).

9. Žiedu „12769 Riga. Ornit. Centrale" pažymėtas paukštis pagautas 19.IV.1930 Alytaus apskr., Daugų miestely.

Svirbelis. Bombycilla garrula. L.

10. Pažymėtas žiedu „F 103515 Vogelwarte Rossitten Germania" buvo nušautas apie Ukmergę 1931 lapkričio mėn. Anot Rasytės stebyklos, jis buvo sužieduotas apie Rasytę 30.X.1931.

Šnekutis. Sturnus vulgaris. L.

11. Žiedu „Ornith. Centr. Riga 23074" žieduotas šnekutis buvo sugautas 1931 pavasarį Ventės km., Kintų valsč., Šilutės apskr. Šis paukštis buvo sužieduotas jauniklis lizde 30.V.1930 palei Tukum, Kurzemė, Latvijoje. Žieduotojas Graf G. Lansdorff iš Riddeldorf'o.

12. Šnekutis žymėtas žiedu „Museum Leiden 102881" buvo rastas beperint Marijampolės apskr. apie Sasnavą 1932 m. gegužės mėn. Jis buvo žieduotas Wassenaar'e netoli Haagos 27.X.1931. Tai yra, be abejo, Lietuvos paukštis, pažymėtas Olandijoje rudens kelionės laiku.

BAGUAGE DES OISEAUX EN LITHUANIE

jusqu'au 31 décembre 1932

avec 4 graphiques

par

T. Ivanauskas,

Professeur de Zoologie à l'Université
de Vytautas le Grand à Kaunas (Lithuanie)

et

A. Vaitkevičius,

Préparateur au Musée d' Histoire Naturelle

Baguage des oiseaux en Lithuanie

jusqu'au 31 décembre 1932.

L'oeuvre du baguage des oiseaux en Lithuanie a été commencée en 1929 par l'Institut de Zoologie à l'Université de Kaunas.

Les bagues, employées au début, avaient été empruntées à la Station de Baguage Rossitten (Allemagne), mais ensuite l'Institut de Zoologie s'est procuré des bagues spéciales séries B, C, D, E avec numéro courant et inscription: Université Kaunas Lithuanie, et séries F, G avec numéro courant et inscription: Université Lithuanie.

Dans le compte rendu suivant, les oiseaux porteurs de bagues de Rossitten sont marqués d'un astérisque, placé à côté du numéro, ainsi que la plupart des captures de ces oiseaux nous sont signalées également par ladite station. Le total d'oiseaux bagués s'éleve à 9296. Nous adressons ici nos remerciements a toutes les personnes qui ont contribué à notre oeuvre, particulièrement à Mr. M. Posingis qui a bagué des milliers d'étourneaux au bord du Kurisch-Haaf. Mais c'est spécialement à Mr. le Dr. E. Schütz, Directeur de la Station de Baguage de Rossitten, qui a bien voulu nous fournir des bagues et nous a renseignés continuellement, que nous exprimons notre reconnaissance.

Anas platyrhyncha. L.

1. Canard sauvage marqué jeune près de Kaunas le 29.VI. 1930 au moyen de la bague C:39437*, a été capturé à Lauenburg, Pommern, Allemagne. Délai 1 an 5 mois et 7 jours. Déplacement 400 km. vers l'ouest-sud-ouest.

2. Sujet D:80 bagué jeune près de Troškūnai, distr. de Panevėžys, a été tué à coup de fusil à 15 km. de Bremen (Allemagne) le 25.XI.1931. Port de la bague 4 mois et 10 jours; déplacement 1080 km. vers l'ouest-sud-ouest.

Vanellus vanellus. (L).

3. Vanneau, sujet E:49165* marqué jeune près de Kaunas entre le 8.VI.1929 et le 22.VI.1929 repris à 30 km. au nord de Lyon, France. Port de la bague 9 mois, déplacement 1780 km. vars le sudouest.

4. Sujet E:57205* bagué jeune près de Guiraud, Sauternes, Gironde, le 8.III.1931. Port de la bague 8 mois, et 20 jours; déplacement 2150 km. vers. le sud-ouest.

5. Sujet E:55209* bagué jeune près de Sintautai, distr. de Šakiai, le 26.V.1930; à été repris à Vendays, Gironde, France, le 10.III.1931. Port de la bague 7 mois et 11 jours. Déplacement 2050 km. vers le sud-ouest.

6. Sujet E:57109* bagué jeune près de Tauragnai, distr. d'Utena, le 10.VI.1930. Débris retrouvées en place le 7.VI.1931.

7. Sujet E:352 bagué jeune à 12 km. au nord de Kaunas le 7.VI.1931. Capturé à Elvas, Portugal, en hiver 1931 (le correspondant n'indique pas la date précise). Déplacement 2950 km. vers le sud-ouest.

8. Sujet E:170 bagué jeune près de Joniškis, distr. de Šiauliai, le 7.VI.1931 a été capturé à Guernica, prov. Vizcaya, Espagne, le 20.II.1932. Port de la bague 8 mois et 13 jours; déplacement 2400 km. vers le sud-ouest.

Megalornis grus. (L).

9. Grue cendrée, oiseau jeune vêtu de duvet, bagué au moyen de la bague B:19269* près de Kaišiadorys, distr. de Trakai, le 6.VII.1929. Dèbris avec bague retrouvées en place au mois de juillet 1931.

Ciconia ciconia. (L).

10. Cigogne blanche, marquée jeune au moyen de la bague B:18504* près d'Užventis, distr. de Šiauliai, au mois de juillet

1930; a été retrouvée morte à Germiston, Transvaal, Afrique du Sud. Port de la bague 9 mois environ, déplacement 9200 km. vers le sud.

11. Sujet B:21524* bagué jeune à Lekiškė, distr. de Panevėžys, le 6.VII.1931; a été trouvé mort près de Nesviž, Russie Blanche (Pologne), le 25.VIII.1931. Le professeur Grochmalicki de Poznan qui a bien voulu nous transmettre le cas, suggère l'idée, que l'oiseau a été tué par ses congénères étant donné qu'il était maladif et très épuisé. Port de la bague environ un an un mois et quinze jours. Déplacement 300 km. environ vers le sud-est-sud.

12. Sujet B:141 bagué jeune au nid près d'Užventis, distr. de Šiauliai, le 20.VII.1931. L'oiseau faisant partie d'une troupe de 50 indivudus environ s'est abbattu sur un conducteur à haute tension et a été tué instantanément à Nikolaiken, Prusse Occidentale, le 29.V.1932. Port de la bague 10 mois et 18 jours. Déplacement 300 km. vers le sud — ouest.

13. Sujet B:16 bagué jeune au nid près de Švenčionys (Svenciany) le 22.VI.1932. L'oiseau a été retrouvé mort près de Samboli, Bulgarie. Port de la bague 11 mois et 20 jours. Déplacement 1400 m. vers le sud.

Ciconia nigra. (L).

14. Cigogne noire. Sujet B:21543* bagué jeune au nid près de Gruzdžiai, distr. de Šiauliai, le 26.VI.1930. L'oiseau a été retrouvé mort à Csongrad, Hongrie, le 6.X.1930. Port de la bague 3 mois et 9 jours. Déplacement 1050 km. vers le sud.

15. L'individu jeune marqué au moyen de la bague B:454 près de Daujėnai, distr. de Biržai, le 24.VII.1932, a été blessé à coup de fusil à 13 km. au sud-ouest de Minsk (Russie) le 12.IX.1932 et après avoir laissé la bague dans la main du chasseur, s'est échappé le jour suivant. (Cas communiqué par le professeur A. Fediuchine, Minsk, Russie). Les circonstances du baguage sont assez intéressantes pour les mentionner ici,

soit: l'oiseau en question a été pris au nid, élevé et bagué par un de nos correspondants. Le bagueur réussit à apprivoiser l'oiseau à ce point que celui - ci étant en pleine liberté le suivait comme un chien. Le 9 septembre le bagueur avait encore l'oiseau entre ses mains, et trois jours plus tard celui - ci fut capturé près de Minsk, après avoir fait un trajet de 340 km. vers le sud-est-sud. Le cas prouve que le baguage des oiseaux apprivoisés peut rendre un service particulier à l'étude de la migration. En effet, dans des cas pareils, il est possible d'établir la date du départ d'une façon précise.

Ardea cinerea. L.

16. Héron cendré, sujet C:36391* annelé jeune, le 18.X. 1929 à Freda au Jardin Botanique de Kaunas, a été capturé à Tortosa, prov. de Tarragona, Espagne, le 5.X.1931. L'oiseau s'est déplacé de 2350 km. vers le sud-ouest, dans un délai d'un an, onze mois et seize jours. (Communiqué par „Sociedad de Cazadores de Tortosa y su Distrito").

Columba palumbus. L.

17. Pigeon ramier, sujet E:972 bagué comme jeune au nid près de Daujėnai, distr. de Biržai, le 21.VIII.1932; a été repris vivant à Marmande (Lot-et-Garonne, France) le 2.X.1932 ou bien un peu avant cette date, car ce n'est „qu'avant de passer l'oiseau à la broche" que le correspondant s'est aperçu de la bague. Déplacement de 2150 km. dans la direction du sud - ouest. Délai 2 mois et 22 jours.

Accipiter nisus. (L).

18. Épervier ordinaire, sujet E:42576* faisant partie d'une nichée de quatre pièces a été marque à la forêt de Kaišiadorys le 23.VI.1928. L'oiseau en question a été retrouvé mort le 4.V.1929 près d'Oborniki — Wronki, Poznań, Pologne. Délai 10 mois et 10 jours. Déplacement 540 km. vers le sud - ouest.

19. Sujet E:41002* faisant partie de la même nichée que le précédent et marqué le même jour a été tué près de Sameliškiai, distr. de Trakai, en automne 1928. Port de la bague quelques mois; déplacement 30 km. environ vers le sud - ouest.

Buteo b. buteo. (L).

20. Buse commune, sujet C:36394* marqué comme jeune près de Kaunas le 25.VII.1925; a été tué à Zöllnitz près de Rochlitz, Saxe, Allemagne, le 16.II.1929. Délai 3 ans, 6 mois et 18 jours. Déplacement 855 km. vers le sud - ouest. Le cas est assez intéressant pour mentionner quelques détails. L'oiseau en question a été pris au nid avec un autre exemplaire de la même nichée et entretenu en captivité quelques semaines; ils étaient nourris de viande et de petits animaux morts. Après quelque temps, les deux individus se sont échappés, et deux ou trois jours plus tard l'un d'eux a été trouvé mort Sa maigreur extrême suggérait l'idée qu'il avait crevé de fain, d'autant plus que les deux oiseaux n'étaient pas habitués à chercher tout seuls leur nourriture. Il est donc remarquable qu'un de ces sujets a non seulement réussi à trouver et capturer sa proie, mais aussi d'éviter ses ennemis pendant trois ans et demi.

21. Sujet C:42090* marqué comme jeune à la forêt de Tyruliai, distr. de Tauragė. a été capturé dans ce même district 3 mois et 16 jours plus tard après s'être déplacé de 10 km. vers le nord — ouest.

Coracias garrulus. L.

22. Rollier. Individu jeune marqué au moyen de la bague E:1098 près de Skaudviliai, distr. de Tauragė, le 10.VI.1932; a été capturé à Vasilies, district de Candie, île de Crète, le 10.IX.1932. Port de la bague 3 mois. Déplacement 2150 km. vers le sud.

Apus apus. (L).

23. Martinet noir. Sujet G:71145* bagué adulte près de la station du chemin de fer Žemaitkiemis le 30.VI.1930; a été repris dans un délai de 17 jours sur le lieu du baguage.

Hirundo rustica. L.

24. Hirondelle de cheminée. Un individu jeune marqué au moyen de la bague G:88713* près de Sintautai, distr. de Šakiai, le 26.VII.1930; a été repris sur le lieu du baguage le 21.V.1931.

25. Individu G:88730* bagué adulte au même endroit que le précédent le 1.VI.1930; a été trouvé mort, le 5.VI.1931, au même endroit où il avait été marqué.

26. Individu adulte marqué au moyen de la bague G:68743* près de Panevėžys le 2.V.1930: a été repris le 26.VII.1931 nichant dans le même nid qu'il a occupé l'année précédente.

Ces trois cas prouvent que l'hirondelle de cheminée aussi bien jeune qu'adulte revient nicher précisément au lieu de sa naissance.

27. Sujet G:97 bagué jeune au nid près de Pagiriai, distr. d'Ukmergė, le 30.VI.1931; a été capturé près de Salisbury, Rhodésie, Afrique du Sud. D'après notre correspondant, M. le Colonel Essex A. Capell, un indigéne a tué l'oiseau „s'envolant d'une fourmilière des fourmis blanches (termites?); dont il faisait la chasse". Port de la bague 5 mois et 14 jours. Déplacement 8100 km. vers le sud.

Delichon urbica. (L).

28. Hirondelle de fenêtre. Sujet G:88647* bagué jeune près de Viduklė, distr. de Raseiniai, le 2.VII.1930; a été trouvé mort à une distance d'un kilomètre du lieu du baguage le 26.V.1931.

Corvus cornix. L.

29. Corneille mantelée. Sujet D:45675* bagué comme jeune près d'Antašavas, distr. de Biržai, le 2.VI.1930, fut repris dans un délai de 4 jours au lieu du baguage.

30. Sujet D:149 bagué jeune prés de Skapiškis le 24.V. 1931, fut repris près de Švitene, distr. de Bauske, Lettonie. Port de la bague 8 mois et 15 jours. Déplacement 80 km. environ vers le nord-ouest.

31. Sujet D:90 bagué jeune près de Viduklė, distr. de Raseiniai, le 24.V.1931; retrouvé mort sur le lieu du baguage le 22.XII.1931.

32. Sujet D:148 bagué jeune à Alytus le 2.VI.1931, a été tué à peu près au lieu du baguage le 6.II.1932. Port de la bague 8 mois et 8 jours.

33. Sujet D:121 bagué comme jeune à Antalieptė, distr. de Zarasai, le 25.V.1931, a été trouvé mort près de Chojnice (wojew. Pomorskie) Pologne, le 20.IV.1932. Il avait porté la bague 10 mois et 26 jours et s'était déplacé de 600 km. vers l'ouest.

34. Sujet D:493 bagué comme jeune au nid près de Mažeikiai le 3.VI.1932, fut tué à coup de fusil à Klink b. Waren (Müritz) Mecklenburg Schwerin, Allemagne, le 25.X.1932. Port de la bague 4 mois et 22 jours. Déplacement 700 km. environ vers le sud-ouest.

Corvus frugilegus. L.

35. Freux, exemplaire jeune, marqué au moyen de la bague D:86 près de Raseiniai le 24.V.1931; a été capturé à Tornham, Kings Lynn Norfolk, Angleterre, le 29.X.1931. Il avait porté la bague 5 mois et 5 jours et avait fait le trajet de 1500 km. environ vers l'ouest.

Sturnus vulgaris. L.

36. Êtourneau. Exemplaire F: 70214* bagué comme jeune à Sintautai, distr. de Šakiai, le 23.V.1930, a été attrapé par un chat à Eydkuhnen Prusse Orientale, le 17.VII.1930. Port de la bague 1 mois et 24 jours. Déplacement 40 km. vers le sud - ouest.

37. Sujet F:60048* annelé comme jeune nid au Jardin Botanique de Kaunas, le 30.V.1930, a été capturé à Dassow, Meklenburg, Allemagne, le 22.VII.1930. Durant un mois et vingt deux jours l'oiseau s'est déplacé de 865 km. vers l'ouest.

38. Porteur de la bague F:68988* sujet jeune marqué près d'Utena; a été capturé à Duffel près d'Anvers, Belgique, le 22.X.1930. (Communiqué par le „Musée Royal d'Histoire Naturelle de Belgique", Bruxelles). Il a porté la bague pendant 4 mois et 19 jours et a couvert le trajet de 1450 km. vers l'ouest.

39. Porteur de la bague F:68926* marqué comme jeune a Troškūnai, distr. de Panevėžys, le 29.VI.1930, a été trouvé mort au mois de novembre de la même année à une distance de 40 km. vers l'ouest. Port de la bague 5 mois environ.

40. Sujet F:69005* marqué jeune près de Rumšiškiai, distr. de Kaunas, le 24.V.1930, a été trouvé mort à Gorinchen, Pays - Bas, le 26.III.1931. Port de la bague 10 mois et 1 jour. Distance couverte 1300 km. vers l'ouest.

41. Sujet F:72518* marqué comme jeune au nid près de Sintautai, distr. de Šakiai, le 5.VI.1930; a été repris au mois de mars 1931 dans le même nid où il était né l'année précédente.

42. Sujet F:70147* marquè jeune au nid près de Jankai, distr. de Šakiai, le 24.VI.1930. L'oiseau a été tué à Hessbögel, Hamburg, Allemagne. Port de la bague 1 an et 11 jours. Déplacement 1050 km. vers l'ouest.

43. Sujet F:501 marqué comme jeune au nid près de Daujėnai, distr. de Biržai, le 2.VI.1931, a été trouvé mort s'étant abattu sur un conducteur à haute tension sur la route de Ganschendorf — Beggerow, Mecklenburg, Allemagne. Port de la bague 2 mois et 25 jours. Déplacement 795 km. vers l'ouest.

44. Sujet F:726 marqué comme jeune au nid près de Vabalninkai, distr. de Biržai, le 31.V.1931, a été tué à Grimhoff Fischhausen, Prusse Orientale, le 20.VII.1931. Il avait porté la bague un mois et 20 jours et s'était déplacé de 320 km. vers le sud-ouest.

45. Sujet F:1033 marqué comme jeune au nid près de Krekenava, distr. de Panevėžys, le 4.VI.1931, a été tué à Neurese Kolberg, Allemagne, le 8.VIII.1931. Port de la bague 2 mois et 4 jours. Déplacement 570 km. vers l'ouest.

46. Sujet F:1201 marqué jeune à Malėtai, distr. d'Utena, le 10.VI.1931; a été capturé par un chat près de Schlochau, Allemagne. Port de la bague 3 mois et 26 jours. Déplacement 750 km. vers le sud-ouest.

47. Sujet F:68997* marqué comme jeune près de Kriukai, distr. de Šiauliai, le 1.VI.1930; tué à Malines, entre Bruxelles et Anvers, Belgique, le 12.X.1931 (Musée Royal d'Histoire Naturelle de Belgique, Bruxelles). Port de la bague 4 mois et 11 jours. Déplacement 1350 km. vers le sud-ouest.

48. Sujet F.362 marqué comme jeune au nid à Prienai, distr. de Marijampolė, le 30.VI.1931; a été tué à coup de fusil à Sosno Szlacheckie, Brodnica, woj. Pomorskie, Pologne, le 9.IX.1931 (d'après Mr. le professeur J. Domaniewski). Port de la bague 2 mois et 9 jours. Déplacement 400 km. vers l'ouest.

49. Sujet F:922 bagué comme jeune au nid à Panemunis, distr. de Rokiškis. L'oiseau a été tué à Semlin, Starogard woj. Pomorskie, Pologne, le 8.IX.1931 (communiqué par Mr. le professeur J. Domaniewski). Port de la bague 3 mois et 9 jours. Déplacement 485 km. vers le sud-ouest.

50. Sujet F:393 bagué jeune au nid près d'Antalieptė, distr. de Zarasai, le 25.V.1931; a été capturé à Blankenberghe au bord de la mer, Belgique, le 13.XI.1931 (Musée Royal d'Histoire Naturelle de Belgique, Bruxelles). Port de la bague 5 mois et 19 jours. Déplacement 1570 km. vers l'ouest.

51. Sujet F:72586* marqué jeune au nid près de Gudžiūnai, distr. de Kėdainiai, le 15.VI.1930, était venu s'abattre contre le phare d'Helgoland la nuit du 30/31 mars 1932. Après avoir remplacé notre bague par la bague 610830 A de la station de Helgoland, l'oiseau a été relâché. Port de la bague 1 an, 9 mois et 13 jours. Distance du lieu de baguage 1035 km. vers l'ouest.

52. Sujet F:68947* bagué adulte au nid près de Gižai, distr. de Vilkaviškis, le 21.V.1931, fut repris au même nid et relâché le 5.IV.1932.

53. Sujet F:68952* bagué comme adulte au nid près de Gižai, distr. de Vilkaviškis, le 21.V.1931; a été repris au même nid et remis en liberté le 5.IV.1932.

54. Sujet F:3812 saisi jeune au moyen d'une tendue à Ventė, distr. de Šilutė, au bord du Kurisch-Haff, le 7.VII.1932. Tué a coup de fusil à Montau Leyden près de Königsberg, Prusse Orientale. Port de la bague 24 jours. Déplacement 85 km. vers le sud-ouest.

55. Sujet F:1361 bagué comme jeune, pris à la tendue à Ventė, distr. de Šilutė, au bord du Kurisch-Haff, le 22.VI.1932; a été atrapé et dévoré par un épervier à Bad Doberau, Mecklenburg, Allemagne, au début du mois d'août. Port de la bague 1 mois et 11 jours environ. Déplacement 620 km. vers l'ouest.

56. Sujet F:1589 bagué jeune, pris à la tendue à Ventė, au bord du Kurisch-Haff, le 26.V.1932, a été trouvé mort à Twielenfleth York, dépendance Stade, le 14.VII.1932 (Comm. par le Dr. O. Schröder, directeur du Musée de Zoologie à l'Université de Kiel). Port de la bague 1 mois et 19 jours. Déplacement 780 km. vers l'ouest.

57. Sujet F:3130 bagué jeune, pris à la tendue à Ventė, au bord du Kurisch-Haff, le 21.VI.1932. L'oiseau a été capturé par un chat près de Schönberg, Holstein, Allemagne, au mois d'août 1932 (Comm. par le Dr. Schröder, directeur du Musée de Zoologie à l'Université de Kiel). Port de la bague 2 mois environ, déplacement 720 km. vers l'ouest.

58. Sujet F:3061 jeune, pris à la tendue à Ventė, au bord du Kurisch-Haff, le 20.VI.1932, a été retrouvé à Fuhlendorf non loin de Barth, au bord de la Baltique, Allemagne. Port de la bague 1 mois et 26 jours. Déplacement 560 km. vers l'ouest.

59. Sujet F:3845 jeune, pris à la tendue à Ventė, au bord du Kurisch-Haff, le 7.VII.1932, a été tué à Laukeninken près de Skaisgirren, Prusse Orientale. Port de la bague 1 mois et demi environ, déplacement 60 km. vers le sud.

60. Sujet F:1591 jeune, pris à la tendue à Ventė, au bord du Kurisch-Haff, le 26.V.1932, a été tué à coup de fusil à la base de la presqu'île de Hel (golfe de Danzig). (Comm. par Mr. le professeur J. Domaniewski, Varsovie). Port de la bague 2 mois et 16 jours, déplacement 170 km. vers le sud-ouest.

61. Sujet F:1387 jeune, pris à la tendue à Ventė, au bord du Kurisch-Haff, le 21.VI.1932, a été capturé et remis en liberté par la Station de Baguage de Helgoland la nuit du 28/29 octobre 1932. Port de la bague 4 mois et 7 jours. Déplacement 870 km. vers l'ouest.

62. Sujet F : 1341 jeune, pris à la tendue à Ventė, au bord du Kurisch-Haff, le 22.VI.1932, a été capturé à Esschen, 25 km. d'Anvers (Comm. par le Musée Royal d'Histoire Naturelle de Belgique, Bruxelles). Port de la bague 3 mois et 3 jours. Déplacement 1200 km. environ vers l'ouest.

63. Sujet F:2091 bagué comme jeune près de Baisogala, distr. de Kėdainiai, le 30.V.1932; a été tué dans une cerisaie à Pillau, Prusse Orientale, le 20.VII.1932. Il avait porté la bague 1 mois et 20 jours et s'était déplacé de 270 km. vers l'ouest.

64. Sujet F:72477* bagué comme jeune près de Pašvitinis, distr. de Šiauliai, le 5.VI.1930, a été retrouvé à Hallern dépendance Stade, Elbe inférieure, Allemagne, le 7.VII.1932. Port de la bague 2 ans, 1 mois et 1 jour. Déplacement 950 km. vers l'ouest.

65. Sujet F:2517 marqué comme jeune près de Radviliškis, distr. de Šiauliai, le 29.V.1932; a été retrouvé mort dans le district de Šilutė un mois et douze jours plus tard. Il s'était déplacé de 140 km. vers le sud-ouest.

66. Sujet F:2875 marqué comme jeune au sud de Šimonys, distr. de Panevėžys, le 3.VI.1932; a été tué à coup de fusil à Barlt Holstein, Allemagne, le 21.VII. Il avait porté la bague 19 jours et s'était déplacé de 1000 km. environ vers l'ouest.

67. Sujet F:3525 marqué comme jeune près de Pakuonis, distr. de Kaunas, le 4.VI.1932. L'oiseau a été capturé au moyen d'un filet à Tönning dépendance Eiderstedt, Allemagne le 21.VII.1932. Port de la bague 1 mois et 18 jours. Déplacement 990 km. vers l'ouest.

68. Sujet F:1205 bagué comme jeune au nid près de Malėtai, distr. d'Utena, le 12.VI.1931, a été retrouvé à Insterburg, Prusse Orientale, le 13.VII.1932. Port de la bague 1 an, 1 mois et 1 jour. Déplacement 240 km. vers le sud-ouest.

69. Sujet F:1819 bagué comme jeune au nid à Prienai, distr. de Marijampolė, le 1.VI.1932; a été retrouvé près de Gumbinnen, Prusse Orientale, le 15.VII.1932. Port de la bague 1 mois et 15 jours. Déplacement 114 km. vers le sud.

70. Sujet F:1122 marqué comme jeune au nid près de Radviliškis, distr. de Šiauliai, le 7.VI.1931. L'oiseau a été capturé à Dudzeele, à 5 km. de Bruges, Belgique, en automne 1931 (Comm. par le „Musée Royal d'Histoire Naturelle de Belgique" Bruxelles). Port de la bague 5 mois environ. Déplacement 1400 km. vers l'ouest.

71. Sujet F:2434 bagué comme jeune au nid près de Radviliškis, distr. de Šiauliai, le 17.VI.1932; a été capturé à Lovendeghem les Gand, Flandre Orientale, Belgique, le 24.X.1932. Port de la bague 4 mois et 7 jours. Déplacement 1450 km. vers l'ouest.

72. Sujet F:2930 bagué comme jeune au nid près de Radviliškis, distr. de Šiauliai, le 29.V.1932. Il a été trouvé mort dans un verger à Auxkallen dépend. Insterburg, Prusse Orientale, le 7.VIII.1932. Port de la bague 2 mois et 9 jours, déplacement 160 km. vers le sud-ouest.

73. Sujet F:1800 marqué jeune au nid à Prienai, distr. de Marijampolė; a été capturé près d'Ostende le 2.XI.1932. Port de la bague 5 mois et 1 jour. Déplacement 1500 km. vers l'ouest.

74. Sujet F:2526 marqué comme adulte près de Daujenai, distr. de Biržai, le 22.V.1932. Il a été tué à coup de fusil à Sennen Cove, Cornwall, Angleterre, le 22.XI.1932 (Communiqué par la rédaction du „British Birds", Londres). Port de la bague 6 mois, déplacement 2100 km. vers l'ouest.

Motacilla alba. L.

75. Bergeronnette grise, individu jeune, a été marqué comme jeune au nid au moyen de la bague G:93134* près de Panevėžys, le 10.VII.1930. Elle a été trouvée morte dans une grange à six kilomètres de distance du lieu de baguage le 29.IX.1931. L'oiseau a donc porté la bague pendant 9 mois et 18 jours et il est revenu près de l'endroit où il était né.

Sitta europaea. L.

76. Sittelle marquée comme jeune au nid au moyen de la bague G:528 à Alytus le 2.VI.1931, a été retrouvée morte à 3 km. du lieu de baguage le 4.IV.1932. Port de la bague 10 mois et 2 jours.

Erithacus rubecula. L.

77. Rouge - gorge pris à la tendue et marqué au moyen de la bague G:3517 à Ventė, au bord du Kurisch-Haff, le 21.X.1932. Il a été capturé par un chat à Vence, Alpes - Maritimes, France, le 27.XII.1932. Port de la bague 2 mois et 6 jours. Déplacement 1650 km. vers le sud-ouest.

Relevé des captures effectuées en Lithuanie jusqu'au 1 janvier 1933 d'oiseaux bagués dans d'autres pays.

Larus ridibundus. L.

1. Goéland rieur marqué au moyen de la bague C:6369 Mus. Zool. Helsingfors, a été capturé au bord du lac Rekijavos, distr. de Šiauliai, le 15.X.1929. D'après la communication du Musée de Zoologie de Helsingfors, l'oiseau a été bagué le 12.VI.1929 près de Helsingfors, Finlande.

2. Goéland rieur marqué au moyen de la bague C:447 Museum Göteborg Sweden; a été capturé sur le lac de Sartai, distr. de Rokiškis, le 30.VIII.1927.

Stercorarius parasiticus. L.

3. Stercoraire parasite marqué au moyen de la bague E:72709 Vogelwarte Rossitten Germania; a été capturé à Ventė, au bord du Kurisch-Haff, le 16.IX.1931. Ce sujet a été bagué à la station de baguage Rossitten le 7.IX.1931.

Crex crex. (L).

4. Les débris d'un crex de prés, marqué „Ornithol. Centr. Riga 44080" ont été trouvés près de Salantai, distr. de Krėtinga. D'après une communication correspondante, l'oiseau a été bagué près d'Adaži, à 40 klm. au nord-est de Riga, Lettonie.

Ciconia nigra. L.

5. Cigogne noire, marqué „Ornith. Centr. Riga 49742"; a été trouvé blessée près de Kuliai, distr. de Krėtinga, le 2.IX.1931. D'après une communication requise, l'oiseau a été bagué près de Aizpute (Hasenpoth), Lettonie, le 2.VII.1931.

Ardea cinerea. L.

6. Héron cendré marqué „B.21970 Vogelwarte Rossitten Germania"; a été tué à coup de fusil près du lac Glebas, distr. d'Alytus, au mois d'août 1930. Une communication de Rossitten nous apprend que le 22.V.1930 ce sujet a été marqué jeune au nid à l'héronniere d'Adlershorst, à 10 klm. environ vers l'est de Neidenburg, Allemagne.

7. Héron, marqué „B.26110 Vogelwarte Rossitten Germania"; a été tué près du lac Siesikai, distr. d'Ukmergė, au commencement du mois de juillet 1931. Il a été bagué, le 28.V.1931, à l'héronnière de Wolka forêt de Drygallen Johannisburg, Allemagne.

8. Héron „B.18859 Vogelwarte Rossitten Germania"; a été tué à coup de fusil près de Ramygala, distr. de Panevėžys, en été 1929. L'oiseau en question a été bagué comme jeune au nid à l'héronnière de Juodkrantė (Schwarzort), le 7.VI.1929.

Accipiter nisus. (L).

9. Épervier ordinaire „12769 Ornith. Centrale Riga"; a été capturé à Daugai, distr. d'Alytus, le 19.IV.1930.

Bombycilla garrula. L.

10. Jaseur „F:103515 Vogelwarte Rossitten Germania"; a été tué à Ukmergė au mois de novembre 1931. Il a été bagué par la station de baguage de Rossitten le 30.X.1931.

Sturnus vulgaris. L.

11. Étourneau, marqué „Ornith. Centrale Riga 23074"; a été pris à la tendue à Ventė, au bord du Kurisch Haff, au printemps 1931. Il a été bagué près de Tukum, Lettonie, le 30.V.1930.

12. Sujet marqué „Museum Leiden 102881"; a été retrouvé couvant près de Sasnava, distr. de Marijampolė, au mois de mai 1932. D'après une communication du Musée de Leiden, l'oiseau a été marqué à Wassenaar près de La Haye le 27.X.1931. Il s'agit certainement d'un oiseau lithuanien marqué en Hollande pendant le passage d'automne.

Prof. P. B. Šivickis

Trikladų regeneracijos fizijologiniai tyrinėjimai

Studies on the Physiology of Regeneration in Triclads

Trikladų regeneracijos fizijologiniai tyrinėjimai.

Paprastai suprantama, kad regeneracija yra tai susidarymas ir išaugimas naujo individo iš atskiro kūno gabalėlio, tačiau platesne regeneracijos žodžio prasme, čia galime skirti ir mažesnius kūno formos ir jo dalių sužalojimų sutaisymus. Matomai tie patys pagrindiniai faktoriai veikia kuomet žaizdos gyja, pražudytieji organai atauga ir kada iš atskiro gabalėlio išauga visai naujas individas. Visas regeneracijos procesas yra labai panašus į embrijogenijos procesą, tačiau skiriasi nuo jo tuo, kad čia sykiu su atstatymo darbu eina ir ardimo senųjų audinių darbas, kitaip sakant, diferencijacija ir dediferencijacija eina greta viena kitos.

Embrijogenija prasideda iš vienos lytinės celės, ovo, kurią pilnai išaugusią vadiname kiaušiniu. Perėjimos ir išaugimo laikais kiaušinyje esančios medžiagos išsidiferencijuoja į savo rūšies individą panašiai kaip ir regeneracijos eigoje. Kaip ta diferencijacija vyksta, kur jinai prasideda ir kur apsistoja, aišku, yra tai istologijos ir citologijos sričių klausimai, kuriais čia neužsiimame. Iš visų esamų dabar įrodymų viena yra aišku, kad regeneracijoje ir embrijogenijoje anksčiau ar vėliau diferencijacijos keliu išauga naujas individas ir kad jo išaugimas matomai priklauso tų pačių pagrindinių principų.

Kaip embrijogenija taip ir regeneracija savo eigoje, galime manyti, yra labai sudėtingi dalykai. Be diferencijacijos ir dediferencijacijos, aišku, reorganizavimos darbe veikia ir kiti faktoriai. Pavyzdžiui, turi būti kokie nors faktoriai, kurie embrijogenijos ar regeneracijos eigai duoda pradžią ir jai vadovauja ir p. Ir jei norime turėti šiokį-tokį supratimą apie tokius visus faktorius, kurie kokiu nors būdu prisideda prie viso išaugimo eigos, turime, jei ne juos pačius, tai bent jų veikimą

kiek nuodugniau ištirti. Taigi šiame darbe ir bandoma patyrinėti kai kurių aiškiau matomųjų faktorių veikimą bendrai visame organizmo kūne jo regeneracijos bėgyje.

Čia anglų kalboje spausdinamame straipsnyje nagrinėjami fizijologiniai trikladų regeneracijos reiškiniai. Dauguma čia aprašomųjų eksperimentų buvo vesti vartojant paprastai visuose Lietuvos vandenyse randamus trikladus, *Planaria lugubris*, o tuos eksperimentus patikrinant vartojami kiti, taip pat dažnai Lietuvoje randami trikladai, *Polycelis nigra*. Šiuose eksperimentuose rasta, kad bendrai imant, regeneracijos eigoje skirtumas tarpe tų dviejų trikladų rūšių yra labai menkas pačiuose savo pagrinduose, nors smulkmenose ir labai žymus. Taigi kas pasakyta apie *Planaria lugubris*, tą patį galima pasakyti ir apie *Polycelis nigra*.

Šios rūšies eksperimentuose labai svarbu turėti vienodą eksperimentinę medžiagą. Daug dėmesio buvo dedama, kad tie gyvulėliai būtų vienodo didumo, vienodai išaugę ir kiek galima vienodi fizijologiškai. Kad tai pasiekti, beveik visi eksperimentiniai gyvuliai, išskiriant tuos, kurie buvo vartojami Birželio grupės eksperimentuose, buvo išauginti laboratorijoje iš regeneravusių individų ir eksperimentus darant labai atydžiai buvo renkami tik pageidaujamo didumo ir vienodumo individai. Visi eksperimentai buvo vedami taip, kad būtų galima jų rezultatus matematikos būdais subendrinti palyginimui eksperimentinių ir kontroliuojamųjų gyvulių regeneracijos greitumą. Ir nors tai visa reikalauja daug darbo, tačiau naudojantis tikimybių teorijomis nėra sunku tai įvykdyti. Taigi visi eksperimentiniai daviniai tabelėse subendrinami aritmetiniais vidurkiais (M) nurodant jų paklaidų galimumus (r).

Tų eksperimentų davinius tyrinėdami randame, jog šių dviejų rūšių trikladų akių regeneracijos greitumas nevienodai yra pasiskirstęs išilgai viso kūno. Pigmentuotoms akims išaugti mažiausiai laiko reikalauja gabalėliai iš pirmgalinės kūno srities, o ilgiausiai iš uodegos srities. Tarpe tų dviejų kraštutinumų eina aiškus gradientas, taip, kad vidutinio normalaus didumo *Planaria lugubris* gabalėliai vieno milimetro vienas nuo kito tolumo, abudu vienodo ilgumo, priešakinis išaugina savo akis beveik aštuoniomis valandomis pirmiau, negu gretimas gabalėlis, paimtas vienu milimetru toliau į uodegos galą. Tas gradientas atsiranda gyvulėliui beaugant lygiai regeneracijos, kaip

ir embrijogenijos eigoje ir visuomet pasilieka labai pastovus. Ligšiolei tą jų pastovumą pasisekė kiek suardyti tik privertus gyvulėlius badauti, kuomet pačios gyvulėlio galinės sritys nuo bendrojo gradiento nutolo.

Gabalėliai iš jaunų gyvulių regeneruoja greičiau, negu iš senųjų. Badavimas, jei neperilgai vedamas, regeneraciją pagreitina, bet ilgesnis badavimas įveda daug nenormalumų. Jei piaustant trikladą į gabalėlius paliekama uodega nenupiauta, tai toksai individas reikalauja ilgesnio laiko regeneruoti akis, negu tas, kuris turi abudu galus nupiautus. Tie visi eksperimentai rodo, kad regeneracijos eiga priklauso audinių diferencijacijos. Jei audiniai diferencijuoti ir jei kokiu nors būdu apsunkinama jų dediferencijacija, tai ilgiau išeina laiko naujo individo kūną sutvarkyti.

Tačiau regeneracijos eiga be audinių diferencijacijos priklauso ir fizijologinių pakitėjimų ir ji pati įveda labai žymius fizijologinius pakitėjimus visame regeneruojančio gyvulėlio kūne. Visoje eilėje aprašytų eksperimentų buvo nupiaustytos gyvulėlių galvos ir leista joms regeneruotis. Paskui kasdieną buvo imama po penkiasdešimtį tų regeneruojančių gyvulėlių, piaustoma juos į šešius lygaus ilgumo gabalėlius ir sekama jų akių pasirodymas. Tie eksperimentai parodė, kad iš regeneruojančiųjų gyvulėlių išpiautieji gabalėliai reikalauja daugiau laiko išauginti savo akis, negu kontroliuojamieji gabalėliai. Ir dėlto, kad tarpe eksperimentinių ir kontroliuojamų gabalėlių yra tik vienas skirtumas, kad vieni piaustyti iš regeneruojančių, o kiti iš normalių gyvulėlių, aišku, kad regeneracijos eiga kliudo gabalėlių regeneracijai. Ir tas fizijologinis kliudymas yra aiškus gale pirmosios dienos, jis nuolatos didėja iki galui ketvirtosios dienos, o apie tą laiką pradeda vėl mažėti. Po kiek laiko ne tik kad tas kliudymas visai išnyksta, bet tie eksperimentiniai gabalėliai pradeda greičiau regeneruoti, negu kontroliniai. Pagrindiniai tas pats kliudymas pasikartoja, regeneruojant nupiautas uodegas, tik jis yra kiek silpnesnis, negu galvos regeneracijoje.

Iš šių eksperimentų aišku, jog normalūs gyvulėliai regeneruodami savo kūno viduje įveda naujus fizijologinius veikimus, kurie yra labai žymūs. Tačiau, jei tie patys gyvulėliai pirmiau yra priversti badauti (eksperimentuose jie badavo 35

dienas), paskui nupiaustomos jų galvutės, ir po to piaustomi į gabalėlius regeneruoti, jie regeneruoja greičiau, negu normalūs gabalėliai. Vadinas, badaudami tos stabdančios jėgos jie netenka.

Taigi, čia išreiškiama nuomonė, jog regeneracijos eiga priklauso dviejų dalykų: audinių diferencijacijos ir bendrosios visame kūne fizijologinės padėties. Audinių diferencijacija yra kiekvienai rūšiai įgimta ir gyvuliui augant jinai didėja, o fizijologinė būklė gali pakitėti įvairioms apystovoms veikiant. Patį stimulą arba sujaudinimą regeneracijos veikimui suteikia irituotasis žaizdos paviršius, kuriame fizijologinis veikimas pasiekia aukščiausio laipsnio. Žaizdos paviršiaus veikimas matomai vadovauja visam regeneracijos darbui, bet jo vadovavimas priklauso to, kaip yra veiklios tos dalys, kurioms jis vadovauja, ir kaip toli jos yra išsidiferencijavusios. Juo veiklesni ir juo labiau diferencijuoti viso gabalėlio audiniai, juo sunkesnis vadovaujančios srities darbas ir tuo silpnesnė regeneracija.

Tai trumpai imant yra viso šio darbo santrauka. Visų smulkmenų pasakoti čia nėra vietos ir bendrai jos yra tik svarbios tuo klausimu įdomaujantiems žmonėms ir dėlto, kad labai mažai tokių žmonių moka lietuviškai, visos smulkmenos rašomos tik anglų kalba.

Studies on the Physiology of Regeneration in Triclads.

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I.

Introductory Remarks.

Apparantly in any organism as a whole there is a tendency to maintain certain degree of a dynamic equilibrium in its body. This property is inherited and specific for different species of individuals. Any disturbance of this equilibrium produces a physiological reaction, the extent of which appears to be to a certain degree dependent upon number of factors, such as the nature of the disturbance, specialization of the tissues involved, etc. In all cases the physiological reaction appears to be the strongest at the immediate point of injury and decreases as it progresses away from this point thus producing a gradient of the physiological activity which has been experimentally demonstrated in different groups of organisms by Child (1928) and his students. The reaction at the point of injury, usually called a wound reaction, appears to be very important factor in different processes of form regulation under various conditions which are found in wound healing, repair of lost tissues, as well as in regeneration and reconstitution of a new individual from a given piece of an organism as a whole, or a part of a whole.

That a reaction at the injured surface of a body, or the wound reaction, leads to an increase of the physiological activities has been known for many years by physiologists, physio-

logical pathologists, as well as by experimental zoologists. Experimentally it has been demonstrated by number of investigators that there is an increase of oxygen consumption (Hyman 1923), increase in CO_2 production (Šivickis 1923), increase in susceptibility to poisons, especially to KNC (Child 1915 and Šivickis 1923), to narcotics (Buchanan 1923), and to alkaloids (Hinrichs 1924) after cutting into pieces of such simple animals as P l a n a r i a, to mention only more prominent instances in this connection. But how this increased activity is distributed along the entire body of the injured animal or a piece, and how long does it persists; what effect it has upon regeneration; is the wound reaction similar in quantity in different regions along the body axis; what effect if any is produced by various general physiological changes in the animal body during starvation, growth, and similar processes especially such which involve certain more or less definite changes in differentiation of the tissues? What effect is produced by the tissues left behind the wound? These and similar questions seem to call for an investigation. In the experiments which are described in this paper, an attempt has been made to find if not an answer, at least a suggestion where to look for an answer.

My acknowledgements are due to the following students of the University: to Mr. K. Motiekaitis for the help in mathematical calculations of some of the data, to Miss. Z. Kurlinskas and Miss. T. Kisielis for the help in making observations during the regeneration of some of the experimental series. Their help is especially valuable on account of the fact that they not knowing the purpose of the work were strictly impartial thus providing a real check upon my own work.

II.

The Material and Methods of Work.

Most of the experiments which are reported in this paper were performed with *Planaria lugubris*, but in a few cases, especially where a check seemed to be necessary, *Polycelis nigra* was used as experimental material.

The original stock of *P. lugubris* was collected from a spring water in the University Botanical Gardens near Kaunas

where they were found by Mr. L. Čeraška of the Zoology Institute. In late spring of 1931 some three hundred specimens were collected and in a due time they were cut into pieces for regeneration. The regenerated pieces were kept in the laboratory and raised to the desired size as will be described together with the experiments. The material obtained in this manner was uniform in age, size and apparantly in a physiological condition. These animals were used in all experiments with an exception of those cases which will be specified in their proper places.

The room temperature is a strong factor in regeneration. Unfortunately our laboratory conditions do not permit a closer regulation of temperature any more than the most of the other zoological laboratories. To minimize an error which may be due to the effect of temperature, the experiments were carried in groups of several parallel series at the same time, one of them at least being a „controlling" series.

The selected animals which were as uniform as possible, were cut into pieces as required by the conditions of the experiment. The cutting operation was performed in a shortest time possible for such an operation to be done properly. The actual cutting in six parts of series of fifty individuals usually is completed in less than one hour. In most of the experiments, as will be seen in the reports, the animals were cut in six equal parts excluding the head. (Cf. Fig. 1). Immediately after cutting, the pieces were placed into Petri dishes in such a way that the pieces from same region of the body of different animals were placed in the same dish. Usually each series was made of fifty worms and since they were cut at the same period, each dish contained fifty pieces from as nearly similar part of the body of different individuals as it was possible to obtain. The dishes were properly labeled, water changed and the median time recorded as the cutting time, or the time for the be-

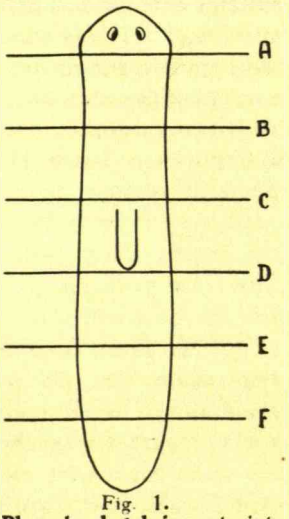

Fig. 1.
Planaria lugubris cut into six equal parts.

ginning of the experimental series under the consideration. The time was recorded to the nearest quarter of an hour. Then the dishes were placed in a diffused light where they were left to the end of the experiment. The following day the water was changed again with special care to remove all disintegrated pieces, the extruded pharynges and any other material which may contaminate the medium. Once in a while it may be necessary to change water after the second day, but the experience has shown that it is seldom necessary to do so and it appears that it is better not to disturb the regenerating pieces until the first examination.

When the regenerating pieces are ready for examination, the entire lot with the dish is placed under the microscope and is examined in a shortest possible time. The time when the regenerating pieces should be examined depends upon the region of the body from which they were cut. Those from the anerior regions usually begin to show the first pigmented eyes at the end of the third day, while those from the posterior regions develop their pigmented eyes considerably later.

The regenerating pieces are examined for the presence of pigmented eyes or the eye spots. It has been shown (Šivickis 1931) that the first appearance of the pigmented eyes is a reliable test for a capability of regeneration of a head in a given species of Triclads which do posses visible eyes. The pigmented eyes spots regenerate under the epithelium. It requires a certain amount of practice to separate eyes from other pigmented bodies which may develop in a newly regenerated epithelium before the eye spots are visible. This is especially true in the pieces from the posterior regions. In the first few days of regeneration it is often necessary to move the pieces with a small camel brush to make the regenerating piece to extend and to expose its eye spots. The main problem in examining is not to miss the time and to see the new eye spots as soon as they develop. It is not easy to get the exact time in all cases and especially so in the anterior region. The „A" pieces often when examined at one time are found to be all eyeless, but if the same pieces are examined six hours later may show 50% or more of the total number of the individuals with clearly developed eye spots. The supposition is, however, that the same thing, or relatively the same

thing happens in other pieces. For this reason the time which is given as required for a piece from different body regions to develop its eyes in reality is shorter than calculated, but since similar error is introduced in the pieces from all regions of the body, the data is considered as correct if not absolutely, then at least comparatively. In tables which will be presented later, only the time in which some change has been noticed is recorded.

The eyes usually develop nearer to the cut surface in the pieces from the anterior regions than in those from the posterior. The pigmented eyes develop deeper in the tissues and therefore for the examination it is necessary to use transmitted light. Sometimes the eye spots may develop nearer the ventral side of the body instead of the dorsal as normally they should develop. Apparantly there is nothing unusual in this phenomenon, especially if we recall that the glass dishes which usually are piled six in a single pile, permit the light to pass from the bottom as well as from the top. This observation is only a casual and has not been studied any further, except as an indication for a reasonably strong transmitted light during the examination of the pieces.

The lens which proved to be most convenient for this purpose is either a combination of Zeiss a_2 objective with 10x ocular, or Zeiss „Plankton" objective with 10x ocular. It does not matter which combination one uses as long as there is a sufficient magnification to see the eye spots and that the distance between the objective and the stage is large enough to permit free movements of the Petri dish.

After a piece has been examined and found to have pigmented eye spots, it is removed from the dish so that it would not interfere in further examinations which may be done on the same or the following day.

Besides the regular tables in which the entire experimental data are summarized, the arythmetical mean is calculated for all the experimental series. This mean time required to regenerate pigmented eyes by the pieces from different regions of the animal body under different experimental conditions, as it was already pointed out, is longer than is the actual time. As absolute measure of a rate of development it would require certain corrections, but as a relative measure it is sufficiently

accurate and very convenient especially for comparison of the regeneration under „normal" and the experimental conditions.

The arythmetical mean, or M, has been calculated to a nearest hour by the generally accepted formula:

$$M = \frac{\Sigma fv}{n}$$

in which **f** is the number of pieces which developed their visible eyes at the end of the time **v** in hours; the **n** is the number of individuals which developed their eyes before the experiment was discontinued. The probable error was calculated using the following formula:

$$r = \frac{2}{3}\sqrt{\frac{\Sigma fd^2}{n-1}}$$

in which **f** has the same meaning as above, the **d** is either positive or negative difference between the given time **v** and the M, or the mean time. Both **r** and M have been calculated in hours in a usual manner. For the details of the meaning and derivation of these formulae one should refer to such standard works as Mellor's (1929).

III.

Regeneration of *Planaria lugubris* under different Conditions which may be found in Nature and in Laboratory.

To have something which may be considered as standard for reference and for comparison of the experimental data it is necessary to examine the capability for regeneration of *Planaria lugubris* under different conditions in which these animals may be found in field and in the laboratory. Most of the experiments included in this group which may be called a „normal" group, include the animals which were used as controls with different experimental series and such animals which were starved or otherwise physiologically modified without actual cutting into pieces. All the modifications which were introduced for this purpose will be seen from the reports of the experiments.

In the first, or the June group of experiments, the animals were brought directly from the field, kept under the laboratory conditions for over two weeks and then cut into pieces. The

age of these animals was unknown, but since they were collected in spring when in our climate no sexual reproduction is found in *P. lugubris* we may suppose that they have developed not later than the previous summer, but there is a possibility that they may have developed even before the summer of 1930.

These animals were cut into pieces and treated in a manner which has been described in the preceding chapter. The data is tabulated in such a way as to present a complete picture in a shortest passible manner.

Table 1.

Series VI. *Planaria lugubris*, 16 mm. Control.
Experiment began 7,15 PM. June 16, 1931.
Number of Individuals cut into pieces—50.
Individuals with eyes at different hours after the cutting:

Region of the body		A	B	C	D	E	F
Hours	93	18	1	—	—	—	—
„	109	39	12	3	—	—	—
„	115	46	32	6	1	—	—
„	136	47	43	26	8	4	—
„	143	—	46	41	22	11	2
„	158	—	47	47	44	29	16
„	167	—	49	48	50	40	27
„	182	—	49	48	—	45	39
„	190	—	49	48	—	49	44
„	205	—	50	49	—	50	47
„	215	—	—	—	—	—	48
„	230	—	—	—	—	—	50
Individuals survived		47	50	49	50	50	50
	M	104	124	139	151	167	175
	r	9.1	14.7	11.2	7.4	9.3	13.4

The data in the tables are given as recorded during the actual observation. The time of examination is given only when there were individuals found to have undergone same change in respect to regenerating eyes. All the examinations in which no individuals with eyes were found are omitted for the economy of space. Both the number of individuals cut for regeneration and the number of pieces survided to the end of the experiment

are given in the tables while the number of pieces which failed to develop their eyes at the end of experiment, where such is a case, can be easily found by subtracting the number of individuals with eyes at the end of the experiment from that which survived to the end.

On examination of the data in the table 1, we see that the first visible eyes begin to develop in the pieces from the anterior end of the body. In the „A" pieces they begin to develop before 93 hours after they were cut from the body, In the „B" pieces they also begin to develop in about 93 hours, in the „C" in about 109 hours, in the „D" pieces in about 115 hours, in the „E" pieces in about 136 hours and in the „F" in about 143 hours after the time they were cut from a corresponding part of the body. The time at which the last pieces from different parts of the body develop the visible eyes is more variable but still shows a general tendency to be the shortest in the anterior pieces. The axial gradient for the capability for regeneration of the pigmented eyes is quite clearly indicated both by the time of the beginning and the end of the regeneration. This axial gradient, however, is best shown by the arythmetical mean, or the median time in hours as expressed by M. The value of M is lowest for the „A" pieces, higher for „B", still higher for „C", etc. and the highest for the „F" pieces. The increase in value of M is very definite and regular. It cannot be considered as being due to an experimental error. In this particular experiment the probable error, or the value of **r** only in one case exceeds ten percent of the value of M. In other experiments as it will appear later, the value of **r** may still be lower without any change in the axiality.

The second group of the experiments was carried in September of the same year, that is, three months later than the June group of experiments. The animals which were used for these experiments were those that have been raised from the regenerated pieces of the June group. They were uniform in age, in size, and apparantly in their physiological condition. The age of these animals was about three months, that is the age at which according to our experience, these animals are already almost mature provided they were taken a proper care during and after the regeneration. But the laboratory conditions in September differ considerably from those in June at least in

temperature and the amount of light, if in anything else, therefore it was desirable to compare these series of the experiments with those of the June as well as with those which were carried still later in the year. The experiments were carried in all details similar to those in the June group. The data for the controlling series is fully summarized in the table 2.

Table 2.

Series XXI. *Planaria lugubris*, 16 mm. Control.
Experiment began 9.00 AM. ,September 19, 1931.
Number of individuals cut into pieces—50.
Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 79	5	—	—	—	—	—
„ 96	34	1	—	—	—	—
„ 105	46	19	1	—	—	—
„ 121	49	41	33	21	8	—
„ 130	—	42	34	25	8	—
„ 144	—	46	43	39	17	—
„ 153	—	47	45	43	30	17
„ 165	—	—	—	49	44	22
„ 192	—	—	—	—	48	32
„ 215	—	—	—	—	48	44
„ 367	—	—	—	—	48	45
Individuals survived	49	47	45	49	50	46
M	98	117	127	133	153	184
r	7.2	8.0	7.2	10.3	13.8	23.3

On examination of the data which are summarized in the table 2, we see that in general the rate of regeneration of the pigmented eyes in pieces from different regions of the body runs exactly in the same direction as in the preceding series, that is, the shortest time required to develop the visible eyes is in the pieces from the anterior regions of the animal body and the longest from the posterior. As indicated by the value of M, the axial gradient is very similar to that in the preceding series. On a closer examination, however, we see in this series some new factors in which this series differs from the preceding: first, the value of M in pieces from all regions with an exception of the „F" is lower than in the preceding series, and

second, some of the pieces from the posterior region failed to develop the visible eyes within the time allowed for the experiments. There were two such individuals from the „E" region and one from the „F". Though in the table 2 the experiment appears as completed at the end of 367 hours after its beginning, these three eyeless pieces were kept under observation for 506 hours, that is for over three weeks and we were fully satisfied that during this time no pigmented eyes developed. Similar cases of failure to develop pigmented eyes have been observed in several other experimental series and in many cases in regenerating *Polycelis nigra*, especially in the pieces from the posterior region of the body. The reasons for the failure to develop pigmented eyes in such pieces have never been investigated.

The following two groups of series of experiments were made with younger animals and will be considered in a different place. But still other two groups of experiments were carried later using normal size animals and these must be included here as normal cases for comparison purposes. One of these groups was carried in December and the other at the end of February of the following year. The material for both of these two groups was raised in the laboratory to the size which is normally found under the field conditions, that is to 16 mm. in length.

The regenerated pieces from the September group of experiments after the examination were transferred into two separate dishes. In one of these dishes were placed the regenerated pieces from the anterior region of the body, that is, from the „A", „B", and „C" regions, and into another the regenerated pieces from the posterior region, that is, the pieces which were cut from the „D", „E", and „F" regions. It was thought that the region from which the pieces were raised may have on influence not only upon their regeneration but even on the subsequent regeneration when they are cut into pieces. The actual tests, however, showed that fully grown animals do not show any physiological difference in respect to regeneration and both types of individuals whether they are raised from the anterior regions of the body, or from the posterior, apparantly do not differ in any respects at least as the physiology of regene-

ration is concerned. (The experimental data to prove this point will be presented later).

The animals which were raised from the regenerated pieces in September to a quite uniform size of ca. 16 mm. were used for the December group of experiments. Some of these animals were sectioned for histological preparations and all of them showed an active spermatogenesis. Several series in this group were cut into pieces in a usual manner and with these there was one controlling series which was carried with the others. The data of this controlling series are summarized in the table 3.

Table 3.

Series 67. *Planaria lugubris*, 16 mm. Control.
Experiment began 2,30 PM. December 18, 1931.
Number of individuals cut into pieces—50.
Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 90	8	—	—	—	—	—
„ 102	38	1	—	—	—	—
„ 117	44	5	—	—	—	—
„ 127	48	17	4	—	—	—
„ 141	49	38	18	6	—	—
„ 151	50	43	43	17	5	—
„ 171	—	49	46	43	28	15
„ 190	—	—	48	48	48	36
„ 219	—	—	—	—	50	45
„ 261	—	—	—	—	—	48
Individuals survived	50	49	48	48	50	49
M	106	140	149	165	179	194
r	8.7	10.5	8.6	9.6	10.0	16.1

From this table we see that the rate of regeneration in these animals is slightly lower than in the preceding two series but as shown by the values of M and r all regions are effected in a same general direction. These values are lower for all regions, and therefore the data may be considered as reliable though not in exact agreement with the values of M in the June and September series.

From the November group of the experiments the regenerated individuals were taken in a similar manner as those in the September and raised to 16 mm. At the end of February a group of series of experiments has been carried with different objects in view and one of these series was considered as a controlling series which has been treated in a similar manner as the experimental series, except that the animals did not have any specific modification which was necessary for the experimental series. The results of the observations on this controlling series are briefly summarized in the Table 4.

Table 4.

Series 98. *Planaria lugubris*, 16 mm. Control.
Experiment began 5,30 PM., February, 29, 1932.
Number of individuals cut into pieces—50.
Individuals with eyes at different hours after the cutting:

Region of the body		A	B	C	D	E	F
Hours	96	46	4	—	—	—	—
„	123	50	25	3	—	—	—
„	145	—	45	37	19	8	1
„	168	—	49	49	45	42	14
„	185	—	—	49	49	48	31
„	208	—	—	49	49	49	37
„	232	—	—	50	49	50	44
„	257	—	—	—	49	—	47
„	280	—	—	—	49	—	49
„	314	—	—	—	50	—	—
Individuals survived		50	49	50	50	50	49
M		98	133	151	164	169	197
r		4.9	11.9	13.3	16.9	10.0	21.3

These four series of experiments which have been just described, were performed using the animals which though developed under different conditions have attained about the same size (ca. 16 mm.) as those which normally develop in our country under the field conditions. It is true that at certain times and in some places in nature one may find *Planaria lugubris* as long as 20 mm., but such cases are rather rare in our waters and cannot be considered as normal. So for our purposes *P. lugubris* of ca. 16 mm. in length is considered

as fully developed normal individual and may be used for comparison with the animals which for experimental purposes in one way or the other were modified physiologically or morphologically, or both.

If we write the values of M of the four series of experiments which may be considered as representing experiments under different normally found environmental conditions, and take the average value for M at different regions of the animal body we have the results which are indicated in the table 5.

Table 5.

The average value of M and its deviation in four controlling series of experiments carried at different times of the year.

	The value of M						Deviations from the average value of M'					
Body Region	A	B	C	D	E	F	A	B	G	D	E	F
Series VI	104	124	139	151	167	175	2	— 5	— 3	7	0	—13
Series XXI	98	117	127	133	153	184	—4	—12	—15	—25	14	— 4
Series 67	106	140	149	165	179	194	4	11	7	7	12	6
Series 98	98	133	151	164	169	197	—4	4	9	6	2	9
Av. M'	102	129	142	158	167	188						

Comparing the values of M' at different regions of the body we see that there is a definite gradient in antero-posterior direction. The shortest time required for the development of the pigmented eyes is in the pieces of the „A" region and the longest in the pieces from the „F" region. The difference between two consecutive regions roughly correspond to about 17 hours with a maximum variation in plus of 10 hours and 8 hours in minus direction. This variation to a certain extent may be considered as being due to an imperfection of cutting of the pieces to intended equal length. But this is merely a suggestion and there may be many other different reasons for this variation of which we know practically nothing at present.

IV.

The Effect of Size and Age of the Animals on the Rate of Regeneration of eyes in *Planaria lugubris* and *Polycelis nigra.*

It is a generally accepted opinion among most of the biologists that older organisms do not regenerate as well as the younger ones with exception of some Triclads in which just the oposite is true. How this idea had developed and how it became almost generally accepted it does not concern us here. In my own work with *Planaria lata* (1923), the experiments on regeneration of that species appeared to indicate that the opinion was correct in a more, or less restricted sense. But it is difficult to accept an idea which appears to be contrary to the experimental evidence on other animals. For this reason as well as for the others which will appear later, it was deemed necessary to carry a few series of experiments in which the difference in the capability for regeneration between larger and smaller, or physiologically older and younger animals of the same species could be compared. Several series of experiments were made and the summarized results will be described in this place.

Table 6.

Series VII. *Planaria lugubris*, 18 mm.

Decapitated 8,00 PM., June 16, 1931.

No. of individuals cut into pieces — 50.

Individuals with eyes at different hours after the decapitation:

Region of the body	A
Hours 93	15
„ 109	40
„ 115	47
„ 136	50
No. survived	50
M 107 r. 8. 4	
Contr. Series VI „A" „ 104	

Series VIII. *P. lugubris*, 12 mm.

Decapitated 8.30 PM. June 16, 1931.

Number of indiv. cut into pieces—50.

Individuals with eyes at different hours after the decapitation:

Region of the body	A
Hours 93	22
„ 109	43
„ 115	46
„ 135	49
No. survived	49
M 104 r 9.5	
Contr. Ser. VI „A" „ 104	

Fifty individuals of the largest size *Planaria lugubris* ca. 19 mm. were selected from the stock which was about two weeks in the laboratory and in a usual manner they were decapitated, placed into Petri dish and left to regenerate their heads. At the same time another series of fifty animals of the smallest available size, ca. 12 mm. of the same species were also decapitated in a similar manner and treated in all respects as the bigger specimens. Both series came from the same stock. The summarized results of the two experimental series are given in the table 6.

From the values of M of these two experimental series and the controlling series we see that there is very little difference between these three series. This difference is so small that their value as it stands alone could not be considered without taking other experiments in consideration. But even in these three series there is slight evidence that we have a de-

Table 7.

Series 68. *Planaria lugubris*, 20 mm. Old animals.
Experiment began 4,00 PM. December 18, 1931.
Number of individuals cut into pieces—50.
Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 89	4	—	—	—	—	—
„ 102	12	—	—	—	—	—
„ 115	26	1	—	—	—	—
„ 126	43	12	1	—	—	—
„ 140	46	30	5	—	—	—
„ 151	48	42	17	5	—	—
„ 170	50	48	35	22	18	12
„ 188	—	50	46	41	34	31
„ 218	—	—	48	45	43	45
„ 243	—	—	49	50	46	48
„ 259	—	—	49	—	48	49
„ 310	—	—	49	—	49	49
„ 338	—	—	50	—	50	50
No. indiv. survided	50	50	50	50	50	50
M	120	144	173	186	195	200
r	11.9	12.0	21.5	16.7	23.3	20.5
Controlling Series 67, M	106	140	149	165	179	194

crease of time required for regeneration with the decrease in size. These experiments however, were performed by a simple decapitation of the largest and the smallest animals available at the time and the controlling series was cut into six parts. There might be a serious objection to such unlike treatment. The amount of tissues left behind the wounded surface may have a considerable effect upon the rate of regeneration. For this reason other series were planned in which the animals were cut in six parts in a usual manner and treated in all respects alike. In one of the series the animals were selected from the stock which was in the laboratory since June. They were almost uniformely 20 mm. in length, that is almost as large as it is possible to get. All of them were old animals collected from the field. The summarized results of the experiments with these animals are shown in the table 7.

The results of the experimental series 68 compared with the summarized results of the parallel controlling series 67, indicate that the pieces which were taken from the larger animals require much longer time to develop visible eye spots than the pieces of the „normal", that is the 16 mm. animals. This

Table 7a.

Series 111. *Planaria lugubris*, 19 mm. Old animals.
Experiment began 11.00 AM. December 30, 1932.
Number of individuals cut into pieces—50.
Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 118	45	3	—	—	—	—
„ 128	47	9	—	—	—	—
„ 143	47	31	12	1	—	—
„ 154	50	41	21	10	4	—
„ 168	—	48	42	41	24	10
„ 190	—	49	47	48	43	31
„ 215	—	—	48	50	48	45
„ 238	—	—	48	—	50	47
„ 262	—	—	50	—	—	50
No. individ. survived	50	49	50	50	50	50
M	120,5	146,5	168,0	170,5	182,7	198,8
r	5.9	9.8	17.7	8.7	12.9	14.6

difference in general exceeds 10% of increase in time in the larger animals above the controlling animals.

To have a still further confirmation of the preceding data the experiment has been repeated at the end of 1932, that is, a year later, using the animals which have been raised from the regenerated pieces which were cut a year ago. These animals by the time of beginning of the experiments were very uniform in size and for the experiment they were selected as near as possible to 19 mm. in length. For the young series, the animals were about five weeks regenerating from the pieces cut from the same stock from which the old animals were taken. The young animals were selected as near as possible of 12 mm. length. The two series were treated in exactly the same manner ant the experimental results are fully summarized in the tables 7a and 7b.

Table 7b.

Series 112. *P. lugubris*, 12 mm. Young animals.
Experiment began 12. 15 PM. December 30, 1932.

Region of the body	A	B	C	D	E	F
Hours 93	12	—	—	—	—	—
„ 119	44	19	6	5	1	—
„ 128	46	33	19	11	4	—
„ 144	47	41	24	17	12	2
„ 154	—	45	40	26	18	7
„ 167	—	—	49	42	33	16
„ 189	—	—	50	48	48	33
„ 214	—	—	—	—	49	33
„ 238	—	—	—	—	—	35
„ 260	—	—	—	—	—	36
No. indiv. survived	47	45	50	48	49	37
M	109,2	129,3	141,3	156,4	163,0	180,8
r	3.4	7.8	12.1	12.1	14.2	16.7

The results of the experiments as shown in two tables, agree very well with those of the preceding experiments and I am fully convinced that the rate of regeneration of pieces cut from smaller younger animals is higher than of those cut from the larger and older animals. These results, however, may be obscured by the fact that the death rate in pieces from the

younger animals is also higher, especially during the first days after the cutting.

All these data show very clearly that the smaller and therefore supposedly the younger individuals of *Planaria lugubris* do regenerate earlier than the larger and supposedly older individuals under similar experimental conditions. This is contrary to my own opinion (1923) which has been based on less accurate experiments with *Planaria lata*. To see whether this change of opinion is justified some experiments were carried using two parallel series of experiments with different species of Triclads, *Polycelis nigra*.

Table 8.

Series X. *Polycelis nigra*, 11 mm.

Decapitated 8,15 PM VII/29/31

No. of individuals decapitated-50.

Individuals with eyes at different hours after the decapitation:

Region of the body	A
Hours 83	6
,, 108	36
,, 115	40
,, 139	42
,, 155	45
,, 180	46
,, 204	49
No. survived	49
M 117 r 20. 1	

Series XI. *Polycelis nigra*, 6 mm.

Decapitated 8.00 PM VII/29/31.

No. of indiduals decapitated - 50.

Individuals with eyes at different hours after the decapitation:

Region of the body	A
Hours 83	8
,, 108	37
,, 116	44
,, 132	46
,, 139	47
,, 154	49
—	—
	49
M 109 r 10. 5	

By the end of July of 1931, hundred individuals of *Polycelis nigra* were selected so that one half of them, that is fifty individuals, were very near 11 mm. long, or the largest that could be obtained from the stock culture and the other half, that is fifty individuals, were very near 6 mm., or about the smallest individuals available for convenient work. All these animals were taken from the same culture stock, which before two weeks was collected from Snaigina Lake in southern part of Lithuania. All these animals were decapitated practically at

the same time, the entire operation of decapitation was completed in less than half hour time. They were treated in all respects alike. The summarized results of these two parallel series are given in the table 8.

Comparing the values of M of the two series of experiments with *Polvcelis nigra* we see very clearly that the smaller and supposedly younger animals do regenerate sooner their eyes than the larger and supposedly older animals. Some other experiments with these two species of Triclads which were performed at different times and which are not reported in this place indicate that we are justified a conclusion that the older (larger) animals do require more time to regenerate visible eye spots than the younger (smaller) animals. Whether this is true with other species of Triclads as well as with these two species, it is not possible at present to say anything.

V.

Effect of Starvation of Planaria lugubris upon the Rate of Development of Pigmented Eyes.

The visual effect of starvation in Triclads is a decrease of the body size and by a general consent of opinion the decrease in size is a process analogous to rejuvenescence. The smaller, or younger animals as shown in the preceding section do develop faster their eyes than the larger, or older animals. If starvation is analogous to rejuvenation, the starved animals should require less time to regenerate their eyes than those which have been recently fed. To test whether this assumption is correct several series of experiments were carried with *Planaria lugubris* in which the animals were left without food for six, ten, twelve and thirty five days respectively. These experiments are described below.

Fifty individuals of *Planaria lugubris* which were raised from the anterior halves of the September group of the experiments were starved for twelve days and cut into six parts in a usual way. At the same time another fifty animals which were fed twenty four hours before sectioning were also cut into six parts as controlling series. Both of these series were taken from the same culture stock and were selected as equal

in size as it was possible to get. The selection was made at the time the starvation series was began to starve. The results of these two parallel series are summarized in the tables 9 and 10.

Table 9.

Series 59. *Planaria lugubris* 13 mm. Raised from A—C pieces. Starved for 12 days before cutting into pieces.

50 amimals cut into pieces at 3.15 PM November 15, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 69	12	—	—	—	—	—
„ 77	25	—	—	—	—	—
„ 93	47	11	—	—	—	—
„ 121	48	48	34	18	7	—
„ 146	—	48	48	44	36	13
„ 163	—	49	48	47	46	27
„ 193	—	—	49	—	47	42
„ 216	—	—	—	—	48	46
„ 241	—	—	—	—	—	47
No. indiv. survived	48	49	49	47	48	47
M	83	116	130	138	148	174
r	7.8	9.2	9.6	9.2	11.5	16.5

Table 10.

Series 60. *Planaria lugubris*, 13 mm. raised from A-C pieces. Fed twenty four hours before cutting into pieces.

50 animals cut into pieces at 3.45 PM. November 15, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 68	6	—	—	—	—	—
„ 77	22	—	—	—	—	—
„ 95	47	22	3	—	—	—
„ 123	—	49	41	34	18	2
„ 146	—	49	49	49	46	13
„ 162	—	50	—	—	49	38
„ 193	—	—	—	—	—	47
„ 216	—	—	—	—	—	48
„ 240	—	—	—	—	—	49
No. indiv. survived	47	50	49	49	49	49
M	85	111	125	130	139	165
r	6.1	10.6	7.7	7.1	8.4	15.3

In comparing the values of M of the recently fed and the starved animals we see that the difference between the values of the two series is rather small. The starved series with an exception of „A" show trom five to nine hours increase in time over that in the controlling series. Since both series of the experiments were carried with animals younger than the „normal" the conclusion cannot be drawn as yet that these results really indicate that the starved animals do require a longer time to regenerate their eyes. One reason for this doubt is that these results do not agree with the generally accepted opinion that a starvation is equivalent to a rejuvenescence. For this reason it was deemed necessary to carry some more experiments with normal animals. Accordingly, several series of experiments were carried with animals of 16 mm. long which were selected from a stock that has been raised in the laboratory. These animals were starved for six and twelve days respectively then they were cut into pieces. The experiment was carried with the same group of experiments in which the parallel controlling series was carried. The summarized results are given in the tables 11, 12 and 13.

Table 11.

Series 75. *Planaria lugubris*, 16 mm. Starved for six days. 50 animals cut into pieces at 8.00 PM. December 22, 1931. Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 95	38	7	—	—	—	—
„ 116	42	21	7	—	—	—
„ 139	50	35	33	23	6	—
„ 164	—	48	48	44	35	13
„ 190	—	—	—	46	45	18
„ 212	—	—	—	48	48	28
„ 238	—	—	—	—	50	38
No. indiv. survived	50	48	48	48	50	39
M	104	133	143	155	172	200
r	11.1	16.8	11.1	12.5	15.1	20.9

Table 12.

Series 80. *Planaria lugubris*, 16 mm. Starved for twelve days.

50 animals cut into pieces at 11.5 AM. December 28, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body		A	B	C	D	E	F
Hours	77	11	—	—	—	—	—
„	101	40	9	1	—	—	—
„	126	48	47	42	25	15	1
„	151	49	48	48	49	31	18
„	173	—	—	—	—	40	27
„	193	—	—	—	—	45	38
„	237	—	—	—	—	46	42
„	288	—	—	—	—	—	44
No. indiv. survived		49	48	48	49	46	46
M		100	122	129	138	154	180
r		10.9	7.3	6.3	8.5	17.4	34.3

Table 13.

Comparison of the values of M of two starved series with the controlling series.

	Value of M						Deviation of value of M from the controlling series.					
Region of the body	A	B	C	D	E	F	A	B	C	D	E	F
Series 75—6 days	104	133	143	155	172	200	—2	—7	—6	—10	—7	+6
Series 80—12 „	100	122	129	138	154	180	—6	—18	—20	—27	—25	—14
Series 67—Fed	106	140	149	165	179	194						

From the data as summarized in the three tables above we see that the value of M is the highest in all regions of the controlling series. The decrease in the values is seen in the animals which were starved for six days and still a greater decrease in the animals which were starved for twelve days. In the latter case this decrease varies from six to twenty seven hours. The animals apparantly are not equally effected by starvation, as indicated by a comparatively high values of **r**, especially after the six day starvation. This value exceeds 10% of the value of M in „A", „B", and „F" pieces of the series 75, but in „A", „E", and „F" in those starved for twelve days of the series 80. In other words

the starvation effect appears to be at first a more pronounced at the anterior end and then progresses to the posterior end. From this group of experiments it is evident that the normal size animals behave differently on starvation than the young animals which were starved before they reached the normal size of 16 mm.

Partly to verify the results of the experiments of the December series, and partly to find any differences in behavior after starvation, two series of experiments were carried with the February group of experiments. The experimental animals were taken from the stock of *Planaria lugubris* raised in the laboratory and selected as near as possible of the same 16 mm. length. One lot of the animals was starved for ten days and the other for thirty five days. Both of these two series together with the controlling series were treated in a usual manner. The results of these experiments are summarized in the tables 14, 15 and 16.

Table 14.

Series 90. *Planaria lugubris*, 16 mm. Starved for ten days. 50 animals cut into pieces at 4.00 PM. February 29, 1933. Individuals with eyes at different hours after the cutting.

Region of the body	A	B	C	D	E	F
Hours 72	8	—	—	—	—	—
„ 91	50	9	—	—	—	—
„ 116	—	46	10	2	—	—
„ 142	—	50	45	36	18	2
„ 162	—	—	48	50	41	13
„ 185	—	—	49	—	47	27
„ 209	—	—	—	—	47	34
„ 233	—	—	—	—	49	43
„ 257	—	—	—	—	49	48
„ 281	—	—	—	—	49	—
„ 315	—	—	—	—	50	—
No. indiv. survived	50	50	49	50	50	48
M	88	114	138	147	165	200
r	4.7	8.5	9.2	7.3	19.9	22.7

Table 15.

Series 94. *Planaria lugubris*, 16 mm. Starved for thirty five days.

50 animals cut into pieces at 4.15 PM. February 26, 1932.

Individuals with eyes at different hour after the cutting:

Region of the body	A	B	C	D	E	F
Hours 97	20	—	—	—	—	—
„ 121	48	21	2	—	—	—
„ 145	49	48	47	41	28	1
„ 164	49	50	50	49	44	12
„ 191	50	—	—	50	48	27
„ 214	—	—	—	—	50	40
„ 239	—	—	—	—	—	44
„ 257	—	—	—	—	—	49
„ 281	—	—	—	—	—	50
No. indiv. survived	50	50	50	50	50	50
M	113	136	145	149	158	202
r	11.5	8.5	4.5	5.9	10.0	20.1

Table 16.

Comparison of the values of M of two starved series with the controlling series.

	Value of M						Deviation of value of M from the controlling series.					
Region of the body	A	B	C	D	E	F	A	B	C	D	E	E
Series 90—10 days.	88	114	138	147	165	200	—10	—19	—13	—17	— 4	3
Series 94—35 days.	113	136	145	149	158	202	15	3	—6	15	—11	5
Serier 98—fed	98	133	151	164	169	197						

Comparing the values of M we see that the starvation of the normal size *P. lugubris* for ten days decreases the time required for regeneration of the pigmented eyes as compared with the controlling series. This agrees with the results of the December series of experiments on starvation. But starvation for thirty five days has a reverse effect on the anterior pieces, though the posterior regions apparantly during this period remain uneffected.

From these experiments it seems that we are justified to say that a short starvation of the fully grown animals increase the rate of regeneration in *P. lugubris* while a pro-

longed starvation decreases the rate of regeneration. In the younger animals even a shorter starvation appears to have a harmfull effect. The effect of starvation seems to be at first more effective at the anterior regions of the body and later it progresses posteriorly. Though the experiments seem to indicate that a starvation does have a rejuvenating effect upon the animal body, but certainly they do indicate that this rejuvenating effect has its limits. These limits still need a further investigation which we hope to carry in a near future.

VI.

Is there any Difference in a Rate of Regeneration of eyes in the Animals raised from different Regions of the Body.

A question may be asked whether there is any difference in the time required for regeneration of eyes in the pieces which were taken from the animals raised from the anterior part of the body as compared with those which were raised from the posterior part. The question has a real importance because there is a marked difference in the capability for regeneration of the pieces from different regions of the body as compared with those which were already presented. When the reconstitution of the individual is complete and this new individual grows to an adult size, may we expect that this new individual acquire a normal intrinsic physiological pattern and loose the characteristic properties of the region from which the regenerating piece was taken? In other words is the morphological form regulation accompanied by a physiological regulation? This is not only a theoretical question, but a practical one as well, or the question of material for the experimental work. It may effect considerably the standardization of the material. Without standardization of material the experimental results would be unreliable.

To test this question experimentally several series of experiments were performed taking a special care in selecting the material from a definite body region. From the September and later groups of experiments the regenerating individuals

were selected into two different pans. Those from the „A", „B", and „C" regions were placed into one pan and were called the anterior animals; those from the „D", „E", and „F" regions were placed into another pan and called the posterior animals. These regenerating individuals were left to regenerate and to grow to a desired size. They were fed same food and treated in all respects alike. These animals when they reached a desired size were cut into pieces for regeneration. The two series of experiments, one with the animals from the anterior region and another with the animals from the posterior region were carried simultaneously. Needless to say that the animals selected for the work in two series were as alike as it was possible to get. The results of these experiments are summarized in the table 17.

Table 17.

Series 52. *P. lugubris*, 9 mm. raised from A, B, C, pieces.
Decapitated 6.0 PM. XI/3/31.
Individuals with eyes at different hours after the decapitation:

Region of the body	A
Hours 72	6
„ 93	49
„ 119	50
No. survived	50

M 91 r 5.4

Series 53. *P. lugubris* 9 mm. raised from D, E, F pieces.
Decapitated 6.30PM. XI/2/1931.
Individuals with eyes at different hours after the decapitation:

Region of the body	A
Hours 72	10
„ 94	49
„ —	—
	49

M 90 r 6.0

Comparing the values of M of these two series of experiments with two different lots of animals, we see that there is practically no difference in the rate of regeneration of the pigmented eyes in these two lots.

The same two lots of animals were kept regenerating their heads for almost twelve days and then they were cut again into pieces, instead of a simple decapitation. The results of these two series of experiments are summarized in the tables 18 and 19.

Table 18.

Series 57. *P. lugubris*, 9 mm. from series 52. 284 hrs. after decapitation.

50 animals cut into pieces at 2.0 PM. November 15, 1931

Individuals at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 68	13	—	—	—	—	—
„ 77	31	—	—	—	—	—
„ 91	43	16	5	1	—	—
„ 123	45	46	39	38	28	4
„ 143	—	—	43	45	42	20
„ 165	—	—	—	—	45	37
„ 193	—	—	—	—	—	41
„ 217	—	—	—	—	—	43
Survived individuals	45	46	43	45	45	44
M	80	112	122	125	132	158
r	8.4	10.3	8.4	6.0	8.7	14.9

Table 19.

Series 58. *P. lugubris*, 9 mm. from series 53, after 283 hrs. after decapitation.

50 animals cut into pieces at 1.30 PM. November 15. 1931.

Individuals at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 69	11	—	—	—	—	—
„ 78	29	—	—	—	—	—
„ 93	47	12	1	—	—	—
„ 120	—	31	31	30	14	—
„ 146	—	—	36	42	39	16
„ 166	—	—	—	—	46	34
„ 194	—	—	—	—	46	38
„ 218	—	—	—	—	46	42
„ 242	—	—	—	—	46	43
Individuals survived	47	31	36	42	47	45
M	82	110	123	127	141	168
r	3.0	8.9	7.0	8.0	10.5	16.5

The animals in two series were cut into pieces after 284 and 283 hours after the decapitation of the young (9 mm) animals. Comparing the values of M at different regions in

two series we see that the difference between them is very slight in the anterior regions and more pronounced in the posterior. These differences may be easily taken as being due to the experimental error.

The experiments have been repeated using the animals from the same stock but larger in size. Instead of 9 mm. they were all selected of a uniform size of 13 mm. These animals were cut immediately into six pieces instead of decapitating first and then cutting into six parts. The two lots of animals were taken from the anterior and the posterior stock cultures respectively and the experimental series were treated in a similar manner. The results are summarized in the tables 20, and 21.

Table 20.

Series 54. *Planaria lugubris*, 13 mm. raised from A, B, C pieces.

50 animals cut into pieces at 7.30 PM. November 3, 1931.

Individuals at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 71	6	—	—	—	—	—
„ 93	44	13	3	—	—	—
„ 119	47	47	33	34	10	—
„ 140	—	49	47	49	48	20
„ 159	—	50	49	49	50	46
„ 188	—	—	49	50	—	48
„ 210	—	—	49	—	—	—
„ 234	—	—	50	—	—	—
Individuals survived	47	50	50	50	50	48
M	92	116	127	126	137	152
r	6.8	9.7	13.9	10.2	6.3	8.1

From the values of M as shown in the summarized results we see that there is a very close agreement between the two series in every part of the body. As a matter of fact such a close, even embarrassing agreement very seldom is obtained with material from the same region of the body of animals raised from the same body region.

From these experiments we may conclude that when the regenerated individuals attain their normal morphological

Table 21.

Series 50. *Planaria lugubris*, 13 mm. raised from D, E, F pieces.

50 animals cut into pieces at 6.30 PM. November 3, 1931, Individuals at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 70	3	—	—	—	—	—
„ 90	44	8	3	—	—	—
„ 118	50	41	34	23	6	1
„ 141	—	47	46	46	41	27
„ 160	—	—	47	—	47	45
„ 188	—	—	—	—	—	49
Individuals survived	50	47	47	46	47	49
M	92	116	123	129	140	152
r	7.1	9.7	8.3	7.7	7.8	9.9

form of the body, they attain their physiological body pattern as well. In the cases under consideration the morphological pattern is acquired when the young animals reach somewhere between the time when they become 9 or 13 mm. in length. When they are only 9 mm. the posterior region of the body apparently is still imperfectly regulated though the anterior region is in a perfect condition. It appears that during the reconstitution and the regulation processes, the general tendency of the regenerating pieces is to attain not only the external form which is inherited in these animals but also the intrinsic physiological pattern which apparantly is acquired during the process of growth and reconstitution.

VII.

Effect of the Posterior End of the Piece upon the Time Required for Regeneration of the Pigmented Eyes in *Planaria lugubris*.

Together with the other experiments of the June group, fifty individuals of *P. lugubris* of a „normal" size 16 mm. were decapitated and allowed to regenerate their heads in a similar manner as in other parallel series. The controlling

series was the one in which the animals were cut in six equal parts. The „A" of the controlling series obviously corresponds to the region which is regenerating in the experimental series. The summarized results are given in the table 22.

When the values of M of the experimental and the controlling series are compared it is clearly seen that the animals which have their posterior ends attached do require o considerable longer time to regenerate their eyes. They are almost entire day behind those which have five sixths of the body beyond the anterior wound removed.

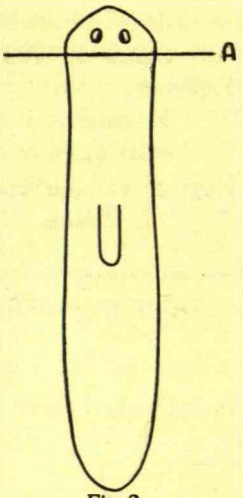

Fig. 2.
Planaria lugubris showing the region at which the animals were decapitated.

Table 22.

Series VIII a. *Planaria lugubris*, 16 mm.
50 animals decapitated at 8. 30 P M. June 12. 1931.
Individuals with eyes at different hours after the decapitation:

Region of the body		A
Hours	97	2
„	121	37
„	145	50
Indiv. survived		50
	M	126 r 8.1
Contr. ser. VI „A"	M	104

Similar experiment has been repeated using 100 animals in the September group of experiments. The results of the experiment are summarized in the table 23.

In this series again the value of M is larger in the animals which had their posterior ends intact as compared with the value of M of the controlling series which was only one sixth of the entire body. In this case the difference between the two series was only ten hours and since it did not correspond to the difference of the first series it was thought

it would be advisable to repeat the experiment with the December group of experiments. The summarized results of this repeated experiment are given in the table 24.

Table 23.

Series XXII. *Planaria lugubris*, 16 mm.
100 animals decapitated at 10.15 A M. Sept. 19, 31.
Individuals at different hours after the decapitation:

Region of the body	A
Hours 80	1
„ 94	25
„ 104	78
„ 121	94
„ 146	100
Individuals survived	100
M	107 r 7. 9
Contr. ser. XXI M	97

Table 24.

Series 62. *Planaria lugubris*, 16 mm.
50 animals decapitated at 8.0 P M. Dec. 17, 1931
Individuals with eyes at different hours after the decapitation:

Region of the body	A
Hours 123	31
„ 133	43
„ 144	50
Individuals survived	50
M	128 r 5.1
Contr. ser. 67 M	105

The value of M in the animals which had only the heads removed again is higher by twenty two hours than in the corresponding region of the controlling series. From all these three series of experiments it is very clear that the tail region has a decided effect upon the regeneration of eyes in the anterior region of the body. The question still may be raised whether a similar effect by the attached posterior region is produced upon the other regions of the body. Only

one series of experiments has been carried to test this question. Fifty animals were cut into two halves that is producing the anterior wound at the place where in the other experiments the „D" pieces are cut. The cut anterior surface corresponds to the „D" region of the controlling series. The rate of regeneration of the „D" region is always lower than that of the „A" region, and for this reason alone it was interesting to see the difference in rate of regeneration between the regenerating pieces with the tails attached and those with the tails removed so that the entire piece was only one sixth in length of the entire body. The experiments were carried together with the preceding series and the results are summarized in the table 25.

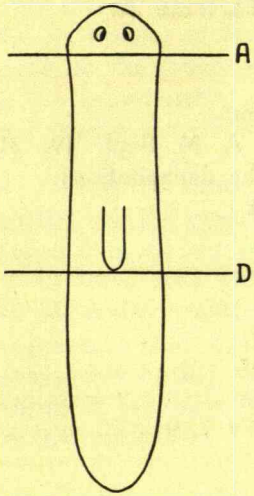

Fig. 3.
Planaria lugubris showing the regions at which the „A" and „D" pieces were cut for regeneration.

Table 25.

Series 63. *Planaria lugubris*, 16 mm.
50 animals cut in two at 4.30 P M. Dec. 17, 1931.
Individuals with eyes at different hours after the cutting:

Region of the body	D
Hours 169	29
„ 189	40
„ 200	47
„ 240	50
Individuals survived	50
M	182 r 12.7
Contr. ser. 67 „D" M	165

The value of M in this region same as in the „A" region of the preceding series is greater by seventeen hours in the

pieces which had their tails attached than in the ones which had them removed.

Examining the results of all these experiments we elearly see that the tail region if left attached to the regenerating piece has a decided hindering effect upon the regeneration of the eyes in the piece in question.

VIII.

Modification of the Time required for Regeneration of pigmented Eyes by Means of an Activation of the Animals before cutting into Pieces.

The experiments which have been already described indicate that the rate of regeneration of pigmented eyes in *Planaria lugubris* proceeds in a very definite manner in respect to the main axis of the body, the size of the animal, the general physiological condition, etc. Now we may ask what physiological changes, if any, are induced by the process of regeneration on the regenerating individual itself. How long these changes remain in the individual and how they are distributed along the main axis of the body.

That there are certain physiological changes induced in the regenerating individual and that these changes hinder the regenerating process has been shown by the writer with experiments on *Dendrocoelum lacteum* (1931). When these animals are decapitated and allowed to regenerate their heads for ten days and then cut into pieces for regeneration, these pieces do regenerate much slower than the controlling pieces taken from the animals which were cut into pieces directly, that is without previous decapitation. These experiments showed quite clearly that there is an increase in the intrinsic physiological activity during the process of regeneration. It was intended to carry this investigation with *D. lacteum* still further but since these animals have never been found in sufficient numbers in Lithuania and the repeated attempt to get them from Tihany (Hungary) failed, we turned to *P. lugubris* as the experimental material. Since these animals are well adopted for the laboratory life, they can be easily raised

to any disirable size within certain limits, their food can be controlled, for this reason they proved to be very desirable material for the continuation of the work which was begun on *D. lacteum.*

To analyze the physiological changes involved during the regeneration process a number of series of experiments were carried using different modifications which are easily controlled or changed. The main object in all cases was to modify the internal physiological factors without a change in the external surroundings in which the pieces are regenerating. For this reason a number of experiments were carried in which the animals were decapitated (Fig. 2), allowed to regenerate their heads and then at the proper time they were cut into pieces and allowed to regenerate their heads and eyes acording to general method which has already been described in different places of this paper. Later it was found desirable to modify this procedure and instead of a simple decapitation, the animals were cut in two halves (Fig. 3), others had their tail-ends removed (Fig. 4), and still others had their tail-ends as well as their heads removed allowed to regenerate for a definite length of time and then at a proper time they were cut into six parts, allowed to regenerate and the the first appearance of the visible eye spots carefully followed and recorded. All these experiments were carried in groups and in all of these groups at least one was considered as a controlling series. The experiments and the summarized data will be given below in the proper places.

IX.

Effect of Decapitation of *Planaria lugubris* upon a subcequent Regeneration of Pigmented Eyes. June Group of Experiments.

A little over two hundred individuals of *Planaria lugubris* had been decapitated, placed in a large culture dish and allowed to regenerate their heads. After twenty three hours fifty of these regenerating animals were taken and cut into six equal parts. The new formed heads during the regene-

ration of these decapitated animals were not removed but left with the „A" pieces. This was an error on our part the meaning of which was not known at that time. Later this error was corrected. All data with the „A" pieces are omited from these tables to avoid confusion. Where this error has been corrected the data will ve included. The summarized data of this series are given in the table 26.

Table 26.

Series I. *Planaria lugubris*, 16 mm. 23 hours after decapitation.

50 animals cut at 4.15 PM. June 3, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 118	—	4	—	—	—	—
„ 145	—	32	10	—	—	—
„ 167	—	50	47	28	16	—
„ 191	—	—	49	45	38	6
„ 216	—	—	49	50	48	41
„ 240	—	—	50	—	50	45
„ 263	—	—	—	—	—	47
„ 292	—	—	—	—	—	49
Individuals survived	—	50	50	50	50	50
M		151	165	174	190	215
r		9.0	9.8	3.8	13.3	18.7

The following day, that is forty seven hours after the decapitation, from the same regenerating lot another fifty individuals were taken and cut in six equal parts. These were treated in a usual manner and the summarized results of this series are given in the table 27.

On the following days in a similar manner lots of fifty regenerating individuals were taken and cut into six equal parts at the time as indicated in each series of the experiments. The actual summarized data of these experiments are given in the tables 28, 29, and 30.

To see the relationship of these experiments with each other it will be best to compare the values of M at different regions of the body of the experimental series with the controlling series. Such a comparison is given in the table 31.

Table 27.

Series II. *Planaria lugubris*, 16 mm. 47 hours after decapitation.

50 animals cut at 4.30 PM. June 4, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body		A	B	C	D	E	F
Hours	140	—	24	5	3	—	—
„	168	—	45	28	17	2	—
„	192	—	50	49	45	37	7
„	216	—	—	50	46	47	22
„	239	—	—	—	49	48	37
„	267	—	—	—	50	50	45
„	287	—	—	—	—	—	47
„	336	—	—	—	—	—	50
Individuals survived			50	50	50	50	50
M			155	176	187	198	236
r			12.1	12.0	10.2	15.4	10.1

Table 28.

Series III. *Planaria lugubris*, 16 mm. 72 hours after decapitation.

50 animals cut at 5.15 PM. June 5, 1931.

Individuals at different hours after the cutting:

Region of the body		A	B	C	D	E	F
Hours	143	—	45	28	17	2	—
„	168	—	46	34	18	6	—
„	191	—	50	50	39	31	8
„	215	—	—	—	47	46	25
„	242	—	—	—	49	50	43
„	262	—	—	—	49	—	48
„	286	—	—	—	50	—	50
Individuals survived			50	50	50	50	50
M			147	161	182	199	233
r			8.8	12.1	22.5	13.3	23.2

Comparing the time required for regeneration at different regions of the body after the animals were regenerating their heads for a definite length of time we see that in all cases it is above the time required for regeneration of

Table 29.

Series IV. *Planaria lugubris*, 16 mm. 94 hours after decapitation.

50 animals cut at 3.45 PM. June 6. 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 121	—	2	—	—	—	—
„ 147	—	29	11	2	—	—
„ 170	—	40	34	13	8	—
„ 193	—	48	46	38	25	5
„ 220	—	49	50	49	41	27
„ 240	—	50	—	49	48	38
„ 264	—	—	—	50	50	49
„ 313	—	—	—	—	—	50
Individuals survived		50	50	50	50	50
M		162	174	193	207	233
r		14.8	13.0	14.3	16.3	17.7

Table 30.

Series V. *Planaria lugubris*, 16 mm. 170 hours after decapitation.

50 animals cut at 7.30 PM. June 9. 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 95	—	1	—	—	—	—
„ 118	—	20	1	—	—	—
„ 145	—	48	27	9	3	—
„ 165	—	50	49	34	20	6
„ 188	—	—	50	49	35	17
„ 213	—	—	—	50	43	33
„ 237	—	—	—	—	50	45
„ 261	—	—	—	—	—	49
Individuals survived		50	50	50	50	49
M		135	155	169	186	211
r		10.4	8.9	9.9	18.1	18.4

the corresponding regions of the controlling series. In all regions, we see a progressive rise in the time required for regeneration with an increase in time allowed for the animals to regenerate their heads. With an exception of „B", „C",

Table 31.

Values of M at different regions of the body of the pieces regenerating for different length of time after the decapitation.

	Value of M					Deviation from the value of M in controlling series.				
Body region	B	C	D	E	F	B	C	D	E	F
Series I 23 h.	151	165	174	190	215	27	26	23	23	40
Series II 47 „	155	176	187	198	236	31	37	36	31	61
Series III 72 „	147	161	182	199	233	23	22	31	32	58
Series IV 94 „	162	174	193	207	233	38	35	42	40	58
Series V 170 „	135	155	169	186	211	11	16	18	19	36
Series VI control.	124	139	151	167	175					

and „D" pieces of the series III (74 hours regeneration), all regions of the body require progressively longer time at least during the first 94 hours of the regeneration. After this time a turning point apparantly is reached, and after 170 hours there is a general tendency for a decrease of the time for regeneration. But even at this time the value of M is still higher than in the controlling series at all regions of the body.

X.

Effect of Decapitation of Planaria lugubris upon a subsequent Regeneration of Pigmented Eyes. September Group of Experiments.

In all June experiments as it has been already noted, the experimental animals were recently brought from the field. They were collected in early part of June and they were at least one year old. It was thought it would be advisable to repeat the same experiments with a standardized material which was raised in the laboratory. Besides this, it was interesting to see whether it is not possible to determine the time at which the decapitated animals during the regeneration of their heads reach the maximum of the hindering effect upon the subsequent regeneration nearer than in the preceding group of the experiments.

On the September 19 a lot of two hundred and fifty individuals were decapitated. These animals were taken from a standardized stock which was raised in the laboratory to the normal size and were as uniform as it was possible to get. After the decapitation they were placed into a large culture dish and left there until they were used for the cutting into pieces for regeneration. In cutting for regeneration the newly formed heads in the „A" region were removed in order to avoid the complication which was noted in the preceding section. The first series of these decapitated animals was cut after twenty four hours, the second after forty seven hours, the third after seventy one hour, the fourth after one hundredth and the fifth after one hundred twenty sixth hour after decapitation. All these series were treated in a similar manner and the entire data are summarized in the tables 32, 33, 34, 35, and 36.

Table 32.

Series XXVI. *Planaria lugubris*, 16 mm., 24 hours after decapitation.

50 animals cut at 10.0 AM. September 20, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 82	1	—	—	—	—	—
„ 96	10	—	—	—	—	—
„ 109	14	—	—	—	—	—
„ 120	27	2	—	—	—	—
„ 127	37	11	5	2	—	—
„ 143	46	39	39	26	17	3
„ 152	46	41	43	34	25	6
„ 167	47	44	45	39	31	13
„ 191	—	45	48	42	42	25
„ 214	—	—	49	45	50	41
„ 242	—	—	—	—	—	47
„ 311	—	—	—	—	—	48
Individuals survived	47	45	49	45	50	49
M	121	142	147	154	168	198
r	12.3	8.6	13.1	14.3	17.9	21.1

Table 33.

Series XXX. *Planaria lugubris*, 16 mm. 47 hours after decapitation.

50 animals cut at 9.15 AM. September 21, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 98	6	—	—	—	—	—
„ 108	10	—	—	—	—	—
„ 122	20	2	—	—	—	—
„ 129	33	23	6	6	—	—
„ 146	40	37	24	12	7	1
„ 168	43	44	28	35	31	19
„ 193	46	47	40	45	45	24
„ 219	—	—	42	46	48	36
„ 239	—	—	—	47	48	39
„ 265	—	—	—	47	48	43
„ 287	—	—	—	47	49	44
Individuals survived	46	47	42	48	49	45
M	131	141	154	168	179	201
r	16.3	12.7	14.3	14.5	16.5	23.8

Table 34.

Series XXIV. *Planaria lugubris*, 16 mm. 71 hours after decapitation.

50 animals cut at 9.30 AM. September 22, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 99	6	2	—	—	—	—
„ 107	9	2	—	—	—	—
„ 129	29	13	2	—	—	—
„ 146	43	31	21	8	2	—
„ 171	45	43	44	28	15	5
„ 196	—	44	47	44	41	29
„ 216	—	45	47	44	45	41
„ 242	—	46	47	44	48	42
„ 264	—	—	47	44	—	46
„ 294	—	—	47	45	—	48
„ 317	—	—	48	45	—	48
Individuals survived	45	46	48	46	48	50
M	131	151	167	178	192	209
r	12.1	17.3	14.8	15.3	13.8	19.4

Table 35.

Series XXXVIII. *Planaria lugubris*, 16 mm. 100 hours after decapitation.

50 animals cut at 2.15 PM. September 23, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 74	3	—	—	—	—	—
„ 101	6	1	—	—	—	—
„ 120	25	4	—	—	—	—
„ 146	36	23	18	13	4	—
„ 172	46	40	42	28	21	3
„ 189	47	44	44	39	31	11
„ 214	47	45	46	44	38	19
„ 236	48	45	46	46	42	30
„ 266	—	45	47	47	49	36
„ 289	—	45	47	48	—	38
„ 313	—	45	47	48	—	41
„ 336	—	45	47	48	—	42
„ 362	—	45	47	48	—	43
Individuals survived	48	46	48	50	49	48
M	137	159	166	182	198	237
r	21.4	14.6	15.0	21.4	21.3	29.8

To compare the results of the entire group of these experimental series as well as to see the deviations of the time required for the regeneration in comparison with the controlling series the values of M of all the experimental and the controlling series are collected in the table 37.

On comparison of the values of M of the different regions of the body of different series with the controlling series we see a definite increase in time in all experimental series, that is in the animals which were for a longer, or shorter time regenerating their heads before they were cut into pieces for the regeneration. In all these series we see a confirmation of the June experiments. There is an increase in time required for the regeneration of eyes after the decapitation at least during the first one hundred hours. And then between one hundred and one hundred twenty six hours a turning point is reached at which

Table 36.

Series XLII. *Planaria lugubris*, 16 mm. 126 hours after decapitation.

50 animals cut at 4.0 PM. September 24,1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 77	1	—	—	—	—	—
„ 97	6	2	—	—	—	—
„ 122	27	5	1	—	—	—
„ 136	39	16	9	—	—	—
„ 169	49	47	41	31	21	7
„ 193	50	47	43	37	35	18
„ 217	—	48	—	38	46	29
„ 241	—	49	—	41	47	40
„ 263	—	—	—	42	47	41
„ 287	—	—	—	—	47	42
„ 311	—	—	—	—	47	48
Individuals survived	50	49	43	42	49	50
M	133	158	163	170	189	224
r	18.0	17.0	10.7	16.8	12.5	28.7

Table 37.

Values of M at different regions of the body of the pieces regenerating for different length of time after the decapitation.

		Value of M						Deviation from the value of controlling M					
Body region		A	B	C	D	E	F	A	B	C	D	E	F
Series XXVI	24 h.	121	142	147	154	168	198	23	25	20	21	15	14
Series XXX	47 „	131	141	154	168	179	201	33	24	27	35	26	17
Series XXXIV	71 „	131	151	167	178	192	209	33	34	40	45	39	25
Series XXXVIII	100„	137	159	166	182	198	237	39	42	39	49	45	53
Series XLII	126„	133	158	163	170	189	224	35	41	36	37	36	40
Series XXI control.		98	117	127	133	153	184						

the time required for regeneration is beginning to decrease. If we compare the turning point of these series with that of the June series we see a general agreement but in the September group apparantly we have approached the turning point slightly nearer to the reality than in the June group of experiments.

XII.

Effect of cutting of tails in Planaria lugubris upon a subsequent Regeneration of Pigmented Eyes.

From the experiments in which the animals were decapitated and were allowed to regenerate their heads we saw that during the regeneration of the lost head there is some physiological change induced into the animal body which hinders the regeneration of the eyes in the pieces which were cut from these regenerating animals. In all cases as we saw there is an increase in the time required for the regeneration of the pigmented eyes until this hindering effect has disappeared. This effect is evidently distributed equally in all regions of the body. The question naturally arises what will happen if instead of removing the head of the animal we should remove its tail. If we cut the tail of the animal and allow it to regenerate for a certain length of time and then cut the animal into pieces, would we get the same effect as in the decapitating, or different, if any?

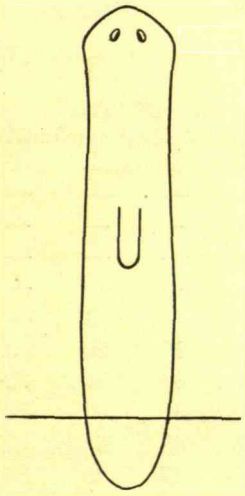

Fig. 4.
Planaria lugubris showing the region at which the tail was cut away for regeneration before cutting into pieces.

To investigate this question a group of experiments was carried at the same time with the September decapitation group. As the experiments were carried together, the same controlling series was used in both cases. The material was taken from the same stock ant treated in all respects alike with the exception that these animals instead of decapitation had their tails removed to an extent slightly less than one sixth of the entire body length. Then they were left to regenerate for a definite length of time after which they were cut into six pieces in a usual manner after twenty four, forty eight, seventy one, one hundred one, and one hundred twenty

Table 38.

Series XXVII. *Planaria lugubris*, 16 mm. 24 hours after tail cutting.

50 animals cut at 11.0. A M., September 20,1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 80	4	—	—	—	—	—
„ 96	33	—	—	—	—	—
„ 105	41	6	—	—	—	—
„ 119	48	12	—	—	—	—
„ 127	—	43	17	4	4	—
„ 141	—	48	34	28	16	2
„ 152	—	50	42	42	36	20
„ 167	—	—	45	46	42	33
„ 189	—	—	50	47	49	45
„ 213	—	—	—	48	50	48
„ 241	—	—	—	—	—	50
Individuals survived	48	50	50	48	50	50
M	99	126	144	148	156	172
r	6.7	7.0	12.5	9.6	12.7	16.4

Table 39.

Series XXXI. *Planaria lugubris*, 16 mm. 48 hours after tail cutting.

50 animals cut at 11.0 A M., September 21,1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 78	3	—	—	—	—	—
„ 97	23	1	—	—	—	—
„ 105	40	3	—	—	—	—
„ 121	47	4	—	—	—	—
„ 129	49	27	12	6	3	—
„ 148	50	39	27	20	28	3
„ 167	—	45	43	37	37	22
„ 193	—	45	46	41	43	28
„ 218	—	45	47	42	44	33
„ 238	—	45	47	42	45	34
„ 264	—	46	47	42	45	34
„ 286	—	—	47	42	45	34
Individuals survived	50	46	48	43	47	35
M	104	140	154	159	160	180
r	8.6	16.0	13.7	13.4	15.1	16.6

Table 40.

Series XXXV. *Planaria lugubris*, 16 mm. 71 hours after tail cutting.

50 animals cut at 1015 AM., September 22, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 102	37	—	—	—	—	—
„ 128	50	23	3	—	—	—
„ 145	—	39	26	15	7	3
„ 170	—	44	38	36	32	16
„ 197	—	44	42	42	43	39
„ 216	—	46	—	43	44	44
„ 241	—	—	—	44	—	47
„ 263	—	—	—	44	—	50
Individuals survived	50	46	42	46	44	50
M	109	142	156	168	174	196
r	7.7	13.9	12.4	14.6	11.9	18.6

Table 41.

Series XXXIX. *Planaria lugubris*, 16 mm. 101 hours after tail cutting.

50 animals cut at 415 P.M., September 23, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 73	1	—	—	—	—	—
„ 100	14	3	—	—	—	—
„ 119	39	17	3	—	—	—
„ 143	45	43	30	16	6	4
„ 169	46	45	45	42	38	24
„ 188	—	—	45	44	41	36
„ 215	—	—	45	44	42	45
„ 235	—	—	45	44	—	46
„ 264	—	—	45	45	—	49
Individuals survived	46	45	46	47	42	49
M	117	132	151	161	165	185
r	11.1	10.6	9.8	13.8	8.8	17.1

six hours, respectively. The experimental results of all these series are summarized in the tables 38, 39, 40, 41, and 42.

Table 42.

Series XLIII. *Planaria lugubris*, 16 mm. 126 hours after tail cutting.

50 animals cut at 515 PM., September 24, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 98	27	3	—	—	—	—
„ 122	49	20	9	1	—	—
„ 136	—	34	21	7	3	—
„ 168	—	46	49	34	41	13
„ 192	—	—	—	38	46	37
„ 214	—	—	—	38	47	47
„ 240	—	—	—	38	—	—
Individuals survived	49	46	49	39	47	47
M	109	135	156	164	169	190
r	8.0	13.7	11.2	11.5	8.8	11.2

If we take together the values of M for all regions of the body and write them together with the controlling series we have the table 43.

Table 43.

Values of M at different regions of the body of the pieces regenerating for different length of time after the tail cutting.

Body region		Value of M						Deviation from the value of controlling M.					
		A	B	C	D	E	F	A	B	C	D	E	F
Ser. XXVII	24 h.	99	126	144	148	156	172	1	9	17	15	3	—12
„ XXXI	48 „	104	140	154	159	160	180	6	23	27	26	7	— 4
„ XXXV	71 „	109	142	156	168	174	196	11	25	29	35	21	12
„ XXXIX	101 „	117	132	151	161	165	185	19	15	24	28	12	1
„ XLIII	126 „	109	135	156	164	169	190	11	18	29	31	16	6
„ XXI Control.		98	117	127	133	153	184						

Comparing the values of M for different regions of the body of the entire group of the experimental series first of all we note a general tendency for a decrease of the value of M in the „F" pieces and second a general increase in these values for the other pieces. The decrease of the time required for the „F" and „E" pieces is fully expected because

they do not represent the real tail region. On account of the operation in cutting the tails in preparing the material for this work, enough of the tail region has been removed to carry the „F" pieces almost entirely into the „E" and „D" regions which always under the normal conditions require less time for regeneration than the „F" or „E" regions. The pieces from the other regions of the body show a general increase in the time required for the regeneration. This increase is not as pronounced as we see in decapitation experiments, nevertheless the general tendency seems to be in the same direction. There is an apparant progressive increase in the time required for the regeneration with the increase in time allowed for the regeneration of the tail until a maximum point is reached apparantly somewhere between the seventy one and one hundred one hours. Somewhere about one hundredth hour after the tails were cut the turning point is reached and the time required for the regeneration remains about the same for at least twenty four hours for which we have any data.

From these experiments it appears that we are justified to say that after the removal of the animal tail the regeneration of a new tail has a similar effect upon the subsequent regeneration of the eyes in *Planaria lugubris* as the regeneration of the removed head, but the effect is less pronounced. The hindering effect in both cases apparantly depends upon the changes involved in the general physiology of the entire body due to the activity of the regenerating new tissues and reorganization of the organs which are concerned in the reconstitution of the individual.

XIII.

The Effect of Cutting of *Planaria lugubris* into two equal halves upon the subsequent Regeneration of Pigmented Eyes.

If the animals are cut into two equal halves, we get two more or less equal parts in which soon after the cutting the anterior part begins to regenerate its tail, and the posterior part begins to regenerate its head. And in this manner we

have a tail regeneration effect upon the „A", „B", and „C" pieces and the head regeneration effect upon the „D", „E", and „F" pieces.

Together with the other experiments of the September group two hundred fifty individuals were selected from the standardized stock of the culture and all of them were cut into two halves. The cutting was carried so as to make the two halves as equal as possible and to have the wound of the posterior half at the region where the usual anterior wound is produced in the „D" pieces of the other experiments. The two lots were placed into two separate culture dishes and left to regenerate in a usual manner until they were taken out in lots of fifty for cutting into three pieces each. In each series of these experiments the lots of fifty were taken from the culture dish at random, therefore the anterior region of a series does not necessary correspond

Table 44.

Series XXIX. *Planaria lugubris*, 16 mm. 23 hours after cutting into two halves.

50 animals cut at 315 PM., September 20, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 93	19	2	—	—	—	—
„ 101	25	6	—	—	—	—
„ 116	32	9	—	—	—	—
„ 123	38	29	4	—	—	—
„ 140	40	42	21	—	15	4
„ 164	—	49	42	—	24	8
„ 198	—	—	48	—	42	24
„ 211	—	—	49	—	50	37
„ 237	—	—	—	—	—	40
„ 258	—	—	—	—	—	42
„ 283	—	—	—	—	—	44
„ 305	—	—	—	—	—	46
„ 336	—	—	—	—	—	47
„ 359	—	—	—	—	—	48
Individuals survived	40	49	49	—	50	50
M	105	129	155	—	177	212
r	10.0	12.7	12.6	—	7.0	31.1

Table 45.

Series XXXIII. *Planaria lugubris*, 16 mm. 47 hours after cutting in two halves.

50 animals cut at 3.15 PM., September 21, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body		A	B	C	D	E	F
Hours	95	8	—	—	—	—	—
„	101	21	—	—	—	—	—
„	117	34	4	—	—	—	—
„	125	45	13	4	—	—	—
„	145	48	33	32	—	5	—
„	165	49	43	42	—	15	5
„	189	—	45	48	—	31	12
„	214	—	—	49	—	48	29
„	234	—	—	49	—	48	36
„	260	—	—	49	—	48	40
„	383	—	—	49	—	48	42
Individuals	survived	49	45	50	—	50	50
	M	115	145	154	—	188	210
	r	11.5	11.9	20.0	—	14.0	16.0

Table 46.

Series XXXVII. *Planaria lugubris*, 16 mm. 71 hrs. after cutting in two halves.

50 animals cut at 215 PM., September 22, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body		A	B	C	D	E	F
Hours	99	18	—	—	—	—	—
„	125	46	18	3	—	—	—
„	143	—	43	24	—	4	—
„	168	—	50	48	—	19	3
„	194	—	—	49	—	33	4
„	212	—	—	—	—	42	21
„	237	—	—	—	—	46	26
„	259	—	—	—	—	49	33
„	296	—	—	—	—	49	41
„	313	—	—	—	—	49	43
„	341	—	—	—	—	50	43
„	360	—	—	—	—	—	45
„	396	—	—	—	—	—	46
Individuals	survived	46	50	49	—	50	50
	M	115	140	155	—	196	248
	r	3.3	12.3	8.1	—	24.0	33.5

Table 47.

Series XLI. *Planaria lugubris*, 16 mm. 98 hrs. after cutting in two halves.

50 animals cut at 4.30 PM., September 23, 1931.

Individuals with eyes at different hours after the cutting

Region of the body	A	B	C	D	E	F
Hours 99	28	—	—	—	—	—
„ 119	41	15	6	—	—	—
„ 144	48	44	27	—	1	—
„ 170	48	46	48	—	16	2
„ 191	48	—	50	—	26	11
„ 215	48	—	—	—	29	22
„ 233	48	—	—	—	33	28
„ 263	48	—	—	—	36	36
„ 286	48	—	—	—	38	39
„ 310	48	—	—	—	38	41
„ 333	48	—	—	—	38	42
Individuals survived	49	46	50	—	42	46
M	111	137	154	—	198	225
r	10.3	9.7	12.7	—	22.3	27.0

Table 48.

Series XLV. *Planaria lugubris*, 16 mm. 125 hrs. after cutting in two halves.

50 animals cut at 9.15 PM., September 25, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 72	1	—	—	—	—	—
„ 95	11	—	—	—	—	—
„ 119	46	11	5	—	3	—
„ 138	48	34	16	—	8	—
„ 166	48	42	38	—	22	4
„ 189	48	—	43	—	39	29
„ 210	49	—	45	—	44	37
„ 236	—	—	—	—	46	41
„ 257	—	—	—	—	46	43
„ 282	—	—	—	—	46	45
„ 306	—	—	—	—	46	47
Individuals survived	49	42	45	—	47	47
M	116	138	159	—	176	207
r	6.3	10.2	16.3	—	21.3	22.1

Table 49.

Values of M at different regions of the body of the pieces regenerating for different length of time after the cutting in two halves.

Body region		Value of M						Deviation from the value of controlling M.					
		A	B	C	D	E	F	A	B	C	D	E	F
Ser. XXIX	23 h.	105	129	155	—	177	212	7	12	28	—	24	28
„ XXXIII	47 „	115	145	154	—	188	210	17	28	27	—	35	26
„ XXXVII	71 „	115	140	155	—	196	248	17	23	28	—	43	64
„ XLI	98 „	111	137	154	—	198	225	13	20	27	—	45	41
„ XLV	125 „	116	138	159	—	176	207	18	21	32	—	23	23
„ XXI Control		98	117	127	—	153	184						

to the parts of the same animals in the posterior regions. But all of them came from the same lot of two hundred fifty which was originally cut into two halves.

The cut pieces were treated in the same manner as in other experiments and the results are summarized in the tables 44, 45, 46, 47, and 48. The newly formed heads in the „D" pieces were not removed before the cutting into pieces. The error was realized later when it was too late to correct it and therefore the data for the „D" pieces can not be considered of much value for the purpose under the consideration and therefore they are omited from these tables.

Collecting the values of M from all regions of the body and writing them in a proper place together so that it would be easier to compare different series with the controlling series, we have the table 49.

On examination of the complete data we see that the results of the entire group of the experiments indicate that the posterior pieces increase the time required for the regeneration of the eyes in a considerably higher ratio than the anterior pieces. The posterior pieces which hawe their heads regenerating behave in a similar manner as the animals in the decapitation groups of experiments. The anterior pieces which have their tails regenerating likewise behave like the animals in the group of the experiments in which the tails were removed. The regeneration of the tail does effect the regeneration of the pieces but to a lesser degree than the regeneration of the head no matter in which region of the body the actual formation of the lost part of the body is taking the place.

XIII.

The Effect of Regeneration of Heads and Tails in *Planaria lugubris* upon a subsequent Regeneration of the Pigmented Eyes.

In the preceding pages we have shown that the regeneration of the new heads and the tails has a marked effect upon the regeneration of the pieces which were taken from these regenerating animals. It was shown that the regeneration of the head has a stronger inhibiting effect than the regeneration of the tail. Even when the regeneration of these two organs are not in their usual place the general effect is the same. The question is what would be the effect on the time required for the regeneration of eyes if the heads and tails of these individuals were regenerating at the same time. Can we expect an increase in time augmented by this process, or a decrease by two different activities, or what? To investigate

Table 50.

Series XXVIII. *Planaria lugubris*, 16 mm. 23 hours after the first operation.

50 animals cut at 2.0 PM., September 20, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body		A	B	C	D	E	F
Hours	94	2	—	—	—	—	—
„	102	3	—	—	—	—	—
„	117	20	3	—	—	—	—
„	125	32	8	—	—	—	—
„	140	37	18	10	4	—	—
„	149	45	30	26	16	6	2
„	164	—	45	36	30	21	5
„	187	—	46	42	39	34	23
„	212	—	47	44	44	44	39
„	238	—	—	—	45	46	43
„	259	—	—	—	45	46	44
„	284	—	—	—	45	46	48
Individuals survived		45	47	44	46	48	48
	M	126	149	158	169	182	206
	r	9.8	12.4	14.7	16.3	18.9	22.1

Table 51.

Series XXXII. *Planaria lugubris*, 16 mm. 46 hrs. after the first operation.

50 animals cut at 1.30 PM., September 21, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body		A	B	C	D	E	F
Hours	94	3	—	—	—	—	—
„	103	14	—	—	—	—	—
„	119	18	—	—	—	—	—
„	126	29	—	—	—	—	—
„	148	41	—	—	19	—	—
„	165	44	—	—	29	—	—
„	190	47	—	—	40	—	—
„	216	—	—	—	43	—	—
„	235	—	—	—	44	—	—
Individuals survived		47	—	—	48	—	—
M		130	—	—	169	—	—
r		17.5	—	—	15.6	—	—

Table 52.

Series XXXVI. *Planaria lugubris*, 16 mm. 68 hrs. after the first operation.

50 animals cut at 11.0 AM., September 22, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body		A	B	C	D	E	F
Hours	102	7	1	—	—	—	—
„	128	29	11	1	—	—	—
„	146	38	29	13	11	10	2
„	171	43	41	33	27	28	2
„	197	44	—	43	39	41	31
„	215	—	—	44	40	42	44
„	241	—	—	46	40	42	46
„	262	—	—	—	40	42	49
„	293	—	—	—	41	43	—
„	340	—	—	—	42	—	—
Individuals survived		44	41	46	43	43	49
M		134	148	174	180	177	205
r		14.2	12.2	16.3	25.2	18.5	14.6

Table 53.

Series XL. *Planaria lugubris*, 16 mm. 96 hrs. after the first operation.

50 animals cut at 3.15 PM, September 23, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 74	5	1	—	—	—	—
„ 101	11	1	—	—	—	—
„ 121	30	6	—	—	—	—
„ 145	44	21	9	10	2	—
„ 171	49	40	37	39	33	13
„ 192	50	41	41	43	41	37
„ 216	—	42	43	46	44	46
„ 235	—	42	—	—	45	47
„ 265	—	42	—	—	45	48
Individuals survived	50	43	43	46	47	48
M	125	155	170	170	178	193
r	18.6	16.2	11.3	12.1	11.5	16.6

Table 54.

Series XLIV. *Planaria lugubris*, 16 mm. 124 hrs after the first operation.

50 animals cut at 7.30 PM., September 24, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 94	5	1	—	—	—	—
„ 120	19	7	—	—	—	—
„ 135	29	16	3	1	—	—
„ 167	39	39	36	36	32	13
„ 190	40	40	37	39	38	43
„ 212		40	37	39	39	46
„ 238	—	41	38	39	39	47
„ 307	—	41	—	40	39	48
Individuals survived	40	42	38	40	40	49
M	134	158	167	171	172	189
r	17.0	17.2	12.3	16.2	7.2	15.3

this question several series of experiments have been carried with the September group of experiments. These experiments are described here.

A lot of worms was selected from the standardized stock, which was raised in the laboratory to the „normal" size of 16 mm. These animals were decapitated and de-tailed at the same operation and placed into the culture dish to regenerate their heads and tails. At the proper time the lots of fifty of these regenerating animals were taken from the culture dish and cut into six pieces. The new heads were removed before cutting into pieces, taking a care, however, to remove as little as it was necessary to do. The regenerating pieces were treated in a usual manner and the summarized results are given in the tables 50, 51, 52, 53, and 54.

Table 55.

Values of M at different regions of the body of the pieces regenerating for different length of time after the first operation.

	Value of M.						Deviation from the value of controlling M.					
Body region	A	B	C	D	E	F	A	B	C	D	E	F
Ser. XXVIII 23 hrs.	126	149	158	169	182	206	28	32	31	36	29	12
„ XXXII 46 „	130	—	—	169	—	—	32	—	—	36	—	—
„ XXXVI 68 „	134	148	174	180	177	205	36	31	47	47	24	11
„ XL 96 „	125	155	170	170	178	193	27	38	43	33	23	9
„ XLIV 124 „	134	158	167	171	172	189	36	41	40	34	19	5
„ XXI Control.	98	117	127	133	153	184						

The values of M of all the series of this group of experiments are taken together for comparative purposes and tabulated in the table 55.

Disregarding the results of the regeneration in the posterior two pieces „E" and „F" on account of the possibility of having them cut more anteriorly as they should be by the removal of the tail, we see a strong increase in the time required for regeneration of eyes in all regions of the body. It appears that the regeneration of the heads and tails at the same time augment their inhibiting effect so that it exceeds the inhibiting effect produced by the regeneration of the head alone.

Effect of the Regenerating Heads and Tails in *Polycelis nigra* upon a subsequent Regeneration of the Pigmented Eyes.

The regeneration of *Planaria lugubris* as shown in the preceding pages is strongly influenced by the regeneration activity of the animal body before it is cut into pieces for the regeneration. It is interesting to compare the behavior of *P. lugubris* with other species of Triclads. Though the first experiments in this line were performed with *Dendrocoelum lacteum* (1931) but since this material was not conveniently available for a more extensive investigation, other species was sought. In our case it happened that *Polycelis nigra* could be found in sufficient numbers for quantitative work and therefore it was used to verify the work with *Planaria lugubris*.

Polycelis nigra is a very common Triclad in some of the Lithuanian waters. In Snaigina lake these animals can be collected by thousands. At first it was thought that it will be the best material for the regeneration studies but soon it was found that it has some rather serious defects. First of all the animal is rather small and it requires more care in handling, second it does not stand well the laboratory conditions. So far we never learned how to feed these animals in the laboratory, and consequently after a certain length of time many animals died of starvation. The mortality of the cut pieces is also considerable and for this reason they should be cut in larger pieces, instead of the usual sixths. However, it provides a good material to verify the work with other Triclads, especially with *Planaria lugubris*. This is the main reason for the presentation of the following experiments.

From the stock culture of *Polycelis nigra* which has been kept for some time in the laboratory for acclimatization, two hundred and fifty individuals were selected as near as possible to the same average lengh of 9 mm. and in a shortest possible time they were decapitated. Fifty of these decapitated animals immediately were cut in two halves so as to separate the body into two equal halves, the anterior corresponding to the „A" region of *Planaria lugubris*, and the posterior, corresponding to the „D" region. The remaining decapitated animals were left in the culture dish to regenerate their heads for a definite length of time. At an expiration of a definite period of time these rege-

nerating animals were cut into two halves. Thus a number of series were produced which were treated alike in all respects with the exception of the time allowed to regenerate the removed heads. The appearance of the first pigmented eyes were noted and the time recorded in a usual manner. The entire data of these experiments are summarized in the tables 56, 57, 58, 59, and 60.

Table 56.

Series XI. *Polycelis nigra*, 9 mm. cut in two halves. Control.

50 animals cut at 7.15 PM., July 31, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	D
Hours 109	2
„ 117	14
„ 135	19
„ 140	23
„ 157	23
„ 164	24
„ 188	29
„ 286	30
Individuals survived	44
M	141 r 28.0

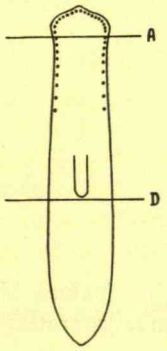

Fig. 5.
Polycelis nigra showing the regions at which the animals were decapitated and cut into two halves for regeneration.

Table 57.

Series XII. *Polycelis nigra*. 9 mm. 22 hrs. after decapitation.

50 animals cut at 16.30 PM. August 1, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	D
Hours 119	9
„ 134	18
„ 140	21
„ 165	27
„ 184	29
„ 215	33
„ 237	35
Individuals survived	49
M	151 r 22.3

Table 60.

Series XV. *Polycelis nigra*, 9 mm. 118 hours after decapitation.

50 animals cut at 6.15 PM. August 5, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	D
Hours 87	6
,, 120	11
,, 141	28
,, 168	34
,, 194	35
,, 234	36
Individuals survived	49
M	138 r 21.3

Table 61.

Values of M at different regions of the body of the pieces regenerating for different length of time after the decapitation.

	Value of M	Deviations from the values of controlling series.
Body region	D	D
Series XII 22 hrs.	151	10
Series XIII 67 ,,	203	62
Series XIV 96 ,,	155	14
Series XV 118 ,,	138	-3
Series XI Control.	141	—

after the decapitation is similar to that in *Planaria lugubris*, except that the turning point appears to be reached much earlier in *P. nigra*. At ninety sixth hour after the decapitation there is a distinct decrease of time required as compared with that at sixty seventh hour. and after one hundred eighteen hours the experimental pieces require even less time than the controlling pieces.

If the decapitation experiments confirm those with *Planaria lugubris* the question is whether cutting of the tails and their regeneration also have a similar effect. To answer this question, another group of experiments was carried eighteen days later than the decapitation experiments.

Table 58.

Series XIII. *Polycelis nigra*, 9 mm. 67 hours after decapitation.

50 animals cut at 3.15 PM. August 3. 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	D
Hours 168	12
„ 187	23
„ 219	33
„ 240	35
„ 267	36
„ 292	38
„ 333	39
Individuals survived	46

M 203 r 24.0

Table 59.

Series XIV. *Polycelis nigra*, 9 mm. 96 hrs. after decapitation.

50 animals cut at 8.15 PM. August 4. 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	D
Hours 111	5
„ 142	16
„ 153	26
„ 190	32
„ 216	35
Individuals survived	45

M 155 r 22.7

During these experiments the „A" pieces were left with the heads regenerating from the time of decapitation and therefore they cannot be properly included with these experiments for the purposes under the consideration. The „D" piece only fall into the line of the experiment and therefore they alone are presented here. The values of M of all these experiments are collected in the table 61.

On comparing the values of M for the regenerating „D" pieces we see that the effect of the regeneration of the head

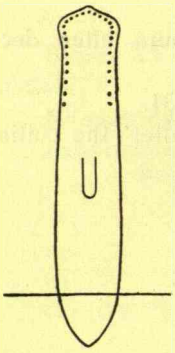

Fig. 6.

Polycelis nigra showing the region at which the tail was removed before cutting into pieces.

Two hundred fifty individuals were selected as near as possible of a size of 9 mm. in length and their tails were cut away. The cut end was about one-sixth part of the entire body length. One series of fifty has been cut immediately into two halves so as to make two pieces comparable to the „A" and „D" pieces of those cut into sixths. Other lots of the regenerating animals were cut at definite time as indicated in the tables. The regenerating animals were treated in a usual manner and the entire data are summarized in the tables 62, 63, 64, 65 and 66.

Table 62.

Series XVI. *Polycelis nigra*, 9 mm. cut in two halves. Control.

50 animals cut at 3.30 PM., August 18, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	D
Hours 101	14	—
„ 118	41	2
„ 137	46	5
„ 144	46	13
„ 161	46	29
„ 168	46	36
„ 184	46	44
„ 192	47	44
„ 208	48	45
„ 232	48	46
Individuals survived	48	47
M	118	162
r	17.0	13.3

Table 63.

Series XVII. *Polycelis nigra*, 9 mm. 22 hours after cutting of the tail.

50 animals cut in two at 3.0 PM., August 19, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body		A	D
Hours	95	4	—
„	113	27	3
„	121	35	4
„	137	40	9
„	145	43	13
„	161	45	29
„	168	46	34
„	185	48	36
„	193	48	37
„	209	49	43
„	216	50	43
„	240	—	44
„	312	—	45
Individuals	survived	50	49
	M	125	166
	r	17.8	23.3

Collecting together the values of M for both regions of all the series we have the table 67.

Comparing the values of M at both regions of all the experimental series we see that the regeneration of the posterior ends in *Polycelis nigra* has a similar effect as the regeneration of the heads. The time required for the reaching of the „turning" point, however, is much longer in the tail-regenerating animals than in the head regeneration. The progressive increase in time continues at least for one hundred seventeen hours after the cutting of the tails.

These experiments can be considered only in connection with those on *Planaria lugubris*. The value of r is rather high and therefore the data may be considered with some suspicion but as a check, they have a real value.

Table 64.

Series XVIII. *Polycelis nigra*, 9 mm. 47 hours after cutting of the tail.

50 animals cut in two at 4.0 PM., August 20, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body		A	D
Hours	96	2	—
„	112	19	—
„	120	29	—
„	136	42	1
„	144	47	3
„	159	48	19
„	170	50	30
„	184	—	36
„	192	—	40
„	208	—	41
„	264	—	45
„	288	—	47
Individuals	survived	50	48
	M	126	174
	r	11.3	24.9

Table 65.

Series XIX. *Polycelis nigra*, 9 mm. 72 hrs. after cutting of the tail.

50 animals cut in two at 4.30 PM., August 21, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body		A	D
Hours	112	5	—
„	119	19	—
„	137	33	—
„	144	45	2
„	159	47	15
„	168	49	27
„	184	49	39
„	192	49	46
„	239	50	48
„	359	—	50
Individuals	survived	50	50
	M	135	182
	r	9.6	22.1

Table 66.

Series XX. *Polycelis nigra*, 99 mm. 117 hours after cutting of the tail.

50 animals cut in two at 2.0 PM., August 23, 1931.

Individuals with eyes at different hours after the cutting:

Region of the body	A	D
Hours 98	3	—
„ 114	11	—
„ 122	30	—
„ 138	38	6
„ 146	42	14
„ 162	46	39
„ 194	—	41
„ 313	—	43
Individuals survived	46	46
M	125	164
r	13.7	13.9

Table 67.

Values of M at different regions of the body of the pieces regenerating for different length of time after the cutting of tails.

		Value of M		Deviation from the value of M in the control series.	
Body region		A	D	A	D
Series XVII	22 hrs.	125	166	13	4
„ XVIII	47 „	126	174	14	12
„ XIX	72 „	135	182	23	20
„ XX	117 „	125	164	13	2
„ XVI	Control	112	162		

XIV.

Effect of the Regenerating Heads of Starved *Planaria lugubris* upon a subsequent Regeneration of Pigmented Eyes.

In all the experiments which were described above, the animals which were used for regeneration were well fed within twenty four hours before the experiments were begun.

In the experiments with the starved animals we saw that normally they do require less time for regeneration if the starvation is carried for a certain length of time. The question is what would be the effect if any if the experimental animals were starved for a considerable length of time, decapitated, allowed to regenerate their heads and then cut into pieces for regeneration. To investigate this point, three hundred individuals of *Planaria lugubris* were selected from the general stock culture and they were set aside in a cuture dish to starve for thirty five days. These animals had as close as possible 16 mm. in their body length. *Planaria lugubris* after reaching this size grow quite slowly and decrease on starvation during this time very little. At the end of this time, fifty animals were cut into six parts for regeneration. This was considered as the controlling series. The others were decapitated, left to regenerate their heads for a definite length of time and then one series after another were cut into six parts in a usual manner. The new heads of the „A" pieces were removed during the cutting into pieces and therefore these pieces can be included with the others. The experimental data of these starved animals are given in summarized form in the tables 68, 69, 70, 71, and 72.

Table 68.

Series 95. *Planaria lugubris*, 16 mm. Starved 35 days, 23 hrs. after decapitation.

50 animals cut at 4.45 PM., February 27, 1932.

Individuals with eyes af different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 96	19	—	—	—	—	—
„ 122	50	23	16	7	—	—
„ 141	—	48	44	36	26	2
„ 167	—	50	50	50	44	16
„ 190	—	—	—	—	50	32
„ 215	—	—	—	—	—	48
„ 304	—	—	—	—	—	49
Individuals survived	50	50	50	50	50	49
M	112	133	138	146	156	191
r	8.7	7.8	9.1	9.9	11.6	20.9

Table 69.

Series 96. *Planaria lugubris*, 16 mm., starved 35 days, 43 hrs. after decapitation.

50 animals cut at 1.30 PM., February 28, 1932.

Individuals with eyes at different hours after the cutting:

Region of the body		A	B	C	D	E	F
Hours	102	35	2	—	—	—	—
„	123	50	35	17	9	1	—
„	148	—	50	43	39	20	3
„	170	—	—	50	50	42	15
„	194	—	—	—	—	49	29
„	212	—	—	—	—	49	43
„	236	—	—	—	—	49	50
„	342	—	—	—	—	50	—
Individuals survived		50	50	50	50	50	50
M		108	130	143	148	168	197
r		6.5	8.1	10.7	9.5	19.1	16.3

Table 70.

Series 97. *Planaria lugubris*, 16 mm. starved 35 days, 69 hrs. after decapitation.

50 animals cut at 3.45 PM., February 29, 1932.

Individuals with eyes at different hours after the cutting:

Region of the body		A	B	C	D	E	F
Hours	76	8	—	—	—	—	—
„	98	45	5	—	—	—	—
„	123	49	39	20	8	4	—
„	145	—	48	47	43	17	5
„	169	—	49	49	50	38	17
„	187	—	—	50	—	43	27
„	210	—	—	—	—	49	38
„	234	—	—	—	—	50	42
„	259	—	—	—	—	—	46
„	291	—	—	—	—	—	47
„	316	—	—	—	—	—	48
Individuals survived		49	49	50	50	50	48
M		96	126	138	145	167	198
r		7.6	9.6	9.6	8.1	16.9	24.7

Table 71.

Series 99. *Planaria lugubris*, 16 mm. starved 35 days, 93 hrs. after decapitation.

50 animals cut at 3.45 PM., March 1, 1932.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 74	3	—	—	—	—	—
„ 101	50	3	—	—	—	—
„ 123	—	38	7	—	—	—
„ 148	—	50	50	31	14	—
„ 164	—	—	—	48	33	7
„ 186	—	—	—	50	44	19
„ 210	—	—	—	—	48	27
„ 234	—	—	—	—	49	36
„ 256	—	—	—	—	—	47
„ 292	—	—	—	—	—	50
Individuals survived	50	50	50	50	49	50
M	99	128	144	155	169	217
r	4.3	9.1	5.9	10.5	13.0	24.7

Table 72.

Series 100. *Planaria lugubris*, 16 mm. starved 35 days 117 hours after decapitation.

50 animals cut at 3.45 PM., March 2, 1932.

Individuals with eyes at different hours after the cutting:

Region of the body	A	B	C	D	E	F
Hours 91	31	—	—	—	—	—
„ 125	50	21	8	1	—	—
„ 143	—	42	42	26	14	1
„ 163	—	50	50	48	32	10
„ 188	—	—	—	50	46	22
„ 210	—	—	—	—	48	30
„ 234	—	—	—	—	50	38
„ 268	—	—	—	—	—	46
„ 290	—	—	—	—	—	48
Individuals survived	50	50	50	50	50	49
M	104	139	143	153	169	211
r	8.5	9.1	7.2	7.9	15.7	25.0

When we collect the values of M for all the regions of the body of these experimental series and write together with the controlling series we have the table 73.

Table 73.

Values of M at different regions of the body of the pieces regenerating for different length of time after the decapitation.

	Value of M						Deviation from the value of controlling M.					
Body region	A	B	C	D	E	F	A	B	C	D	E	F
Series 95 23 hrs.	112	133	138	146	156	191	— 1	— 3	—7	—3	—2	—11
Series 96 43 „	108	130	143	148	168	197	— 5	— 6	—2	—1	10	— 5
Series 97 69 „	96	126	138	145	167	198	—17	—10	—7	—4	9	— 4
Series 99 93 „	99	128	144	155	169	217	—14	— 8	—1	6	11	15
Series 100 117 „	104	139	143	153	169	211	— 9	3	—2	4	11	9
Series 94 Control	113	136	145	149	158	202						

From the data presented in the table 73 we see that the pieces cut from the animals which were starved for 35 days in general do regenerate their eyes in much shorter time than those from the recently fed animals. The effect of the starvation is visible in all regions but the effect of the regeneration activity may still be seen in the posterior regions, especially in the „D" and „E" regions. The starvation effect appears to be more pronounced in the anterior regions of the body.

XV.

Discussion.

In considering the presented data as a whole we see that there is a definite gradient along the main axis of the body in capability for regeneration of eyes in *Planaria lugubris* and in *Polycelis nigra*. This gradient appears to be very constant and very definite. Under the „normal" conditions the difference in the rate of regeneration of the eye spots, in the pieces taken from two adjacent regions of *P. lugubris* is about 17 hours. Since the „normal" size of the animals is about 16 mm. and

the removed head amounts to almost 2 mm. then the average length of the pieces may be considered roughly about two millimeters each. Thus the axial gradient in respect to the time required for the regeneration of eyes is about 8 hours per millimeter. This is a general statement, because the actual difference between two adjacent regions may differ considerably in some regions of the body. The greatest differences are between „A" and „B", and „E" and „F" regions. These differences can be accounted quite readily remembering the fact that in „A" pieces we may expect to have more nervous tissue left during the cutting into pieces. And as the regeneration of eyes apparantly corresponds to the regeneration of the nerves, the larger amount of the nervous tissue left evidently hastens the regeneration of eyes in the „A" pieces thus producing a marked difference in the regeneration time between the „A" and „B" pieces. The difference in time required for the regeneration of eyes in the „E" and „F" pieces evidently is due to the delay in regeneration in the „F" pieces on account of the uninjured part of the posterior end of the pieces. As it is demonstrated in the section VII the attached tail to the regenerating piece may increase the time required for regeneration from ten to twenty four hours over that required by the pieces of the same region of the controlling series. (Cf. tables 22 — 25).

Bearing in mind the higher difference in the time required between the most anterior and the most posterior regenerating pieces and taking average differences between two consecutive pieces in the experiments in which the „normal" starved, decapitated, and decapitated after thirty five days of starvation animals were used, we see that this average is quite stable. Under all extreme conditions in these experiments this average fluctuates from 14.8 to 23.6 hours. There is more variation in starved animals than in any others. With starvation apparantly there is a certain disarrangement of the general physiological pattern of the animal body. Since this average difference in reality represents the axial gradient of the species, we may conclude that the gradient itself is very stable.

The axial gradient may vary considerably in different species of the Triclads. (Cf. Šivickis 1931a) but in a given

species certainly it must be stable. These gradients are produced during the process of differentiation of the animal as has been demonstrated in the section VI of this paper. The young animals which have been raised from two different regions of the body, both representing the highest and the lowest levels of the gradient in the old animal body, during the growth and differentiation acquire exactly the same axial gradient. (Cf. tables 17 — 21). And this gradient is relatively a very stable gradient. During the process of regeneration of the new heads or the new tails we can increase considerably the time required for the regeneration of the eyes in the cut pieces, that is we can slow down the process of regeneration, but the general gradient between the anterior and the posterior regions of the body remains practically the same. And since it is a stable gradient we must consider it as analoguous to the growth gradient in a sense of Huxley (1932). Since the younger animals regenerate in a shorter time than the older animals, we may assume that this regeneration gradient is really a differentiation gradient.

Thus the rate of regeneration depends apparantly upon the differentiation gradient of the tissues, along the main axis of the body. These differentiated tissues provide only the material from which the new individual may or may not regenerate into a new individual. The actual process of regeneration must depend upon the physiological gradients of Child (1928). That is by the act of cutting the animal into pieces we produce a very strong stimulus in the wound region. This stimulus assumes a leading, or dominant action, in the regenerating process. Its dominance, however, depends how active physiologically are the tissues in the regions posterior to the wound. During the regeneration of the cut head, or tail, the physiological activity is raised in the entire body. This activity is more pronounced during the regeneration of the head than that of the tail. In both cases the dominance of the anterior wound region is relatively decreased and as a result of it the piece requires a longer time for reorganization of its nervous tissues and the reconstitution of the new eyes.

The regeneration of the decapitated or the de-tailed animals give us a clue to the rate of the physiological activity involved during the process of regeneration at different times

from the cutting into the pieces. This physiological activity is noted at the end of the first day, progresses for the first three or four days, then begins to decline, and if the regeneration is carried long enough, not only it dissapears entirely, but by producing a young animal, that is by a rejuvenation of the regenerating tissues, it actually decreases the time required for regeneration. The climax of the regeneration activity which is effective in slowing down the regeneration process corresponds roughly to the regeneration of the eyes at the anterior end of the body, that is, at the „A" region. At this time apparantly there is a dedifferentiating activity in the tissues. It would be a mistake to suppose that a reconstruction activity would be stopped at this time. The reorganization of the individual requires several weeks to be something like at a state of completion. Thus in reality the regeneration activity which is effective in slowing down the process of regeneration is a process of dedifferentiation of the old tissues.

That the hindering effect is produced during the process of dedifferentiation of the old tissues is shown by the absence of such hindering effect in the regenerating pieces from the animals which have been starved for thirty five days. During the prolonged starvation apparantly there is a considerable dedifferentiation of the tissues as it is shown by a decrease of the time required for regeneration, and by a general rejuvenescence as has been shown by Child (1915) and a number of other investigators in this field. In our experiments the regenerating pieces taken from the decapitated animals which were starved for thirty five days show a decided decrease in the time required for regeneration of the eyes as compared with the pieces from the same regions of the controlling series. Only the tissues at the posterior end of the body which may be supposed as less effected by the starvation show something like a normal behavior, (Cf. tables 68 — 73), that is, an increase in the time required during the regeneration of the heads before cutting into pieces.

The hindering effect of the dedifferentiating activity is also shown by the experiments in which the tail region is left attached to the regenerating piece as indicated in the experiments in the section VII (Cf. tables 22 — 25). In a reasonably short piece which has two wounds, one at the anterior and

another at the posterior ends we may assume that the dedifferentiation activity begins immediately after the cutting at both wounded surfaces and thus prepares the tissues sooner for the reconstitution activity than working from only one end of the piece. In long pieces this increase of the dedifferentiation activity from both ends may not be as effective as in the short pieces as it appears to be the case in the experiments in which the tails and heads were removed and allowed to regenerate before the cutting into pieces for regeneration.

XVI.

Summary and Conclusions.

1. A number of experiments were performed investigating the time required for regeneration of pigmented eyes at different levels of the main body axis in *Planaria lugubris* and *Polycelis nigra*. In all of the experiments with *Planaria lugubris* with an exception of the first or the June group, the experimental material was raised in the laboratory to a desired size and a uniform physiological condition. Some of the experiments were repeated using *Polycelis nigra*. All these experiments are to be considered as quantitative in nature. In each group of the experiments a sufficient number of standard animals was used to permit a regular mathematical calculation of the median time (M) required for the regeneration of the pigmented eyes for the pieces at different regions along the main axis of the body.

2. The results of the experiments indicate that there is a definite regeneration gradient along the main axis of the body of these Triclads. This regeneration gradient probably is analogous to the Huxley's growth gradients. It is acquired during the differentiation of the tissues in the process of the morphogenesis and the regulation of the form of the body.

3. The changes in this axial gradient have been produced by different methods which supposedly have induced a change in the intrinsic physiological activity within the body. But in all cases in which such changes were produced either lowering

or raising the rate of regeneration proceeds more or less at the same ratio in all regions along the main axis of the body, providing there are no special hindering or accelarating factors involved. Some of such factors appear to be present in the process of starvation. In general the process of regeneration must be considered both as a local, and as a general reaction in the body.

4. The regeneration of the removed head, tail, or both, increase the time required for the regeneration of eyes in the pieces which are cut from these regenerating animals. At the end of the fourth day the regeneration effect begins to disappear and eventually disappears entirely. Later the time is reached when the pieces from such regenerating animals actually require less time to regenerate their eyes than the controlling pieces.

5. Young animals and the animals which were starved for some time, regenerate their eyes in a shorter time than the old and recently fed animals. The starvation for thirty five days appears to produce an opposite effect and the animals which were starved for such a long time require more time to regenerate their eyes than the controls and those which were starved for ten or twelve days, but the data though suggestion is not conclusive.

6. The pieces from the animals which were starved for thirty five days when decapitated and allowed to regenerate their heads and then cut into pieces require less time to regenerate the pigmented eyes than the pieces from the same regions of the starved but not regenerating animals.

7. The regenerating pieces which have only one wound at the anterior end require more time to regenerate their eyes than the pieces from the same region but with two fresh wounds, one at the anterior and one at the posterior end. It appears that the posterior wound reaction is effective in one-sixth pieces of *Planaria lugubris*, while the activity in longer pieces is not noticeable as shown in the experiments in which the head and the tail of the animal have been removed and regenerating before the cutting into pieces.

8. The regeneration activity is considered as depending upon two different factors at least: the axial differentiation

gradient of the tissues and the Child's physiological axial gradients. The differentiation gradient is produced during the process of morphogenesis and is more or less stable in a given species, while the axial physiological gradient is induced by the wound stimulus in the act of cutting the pieces for regeneration.

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